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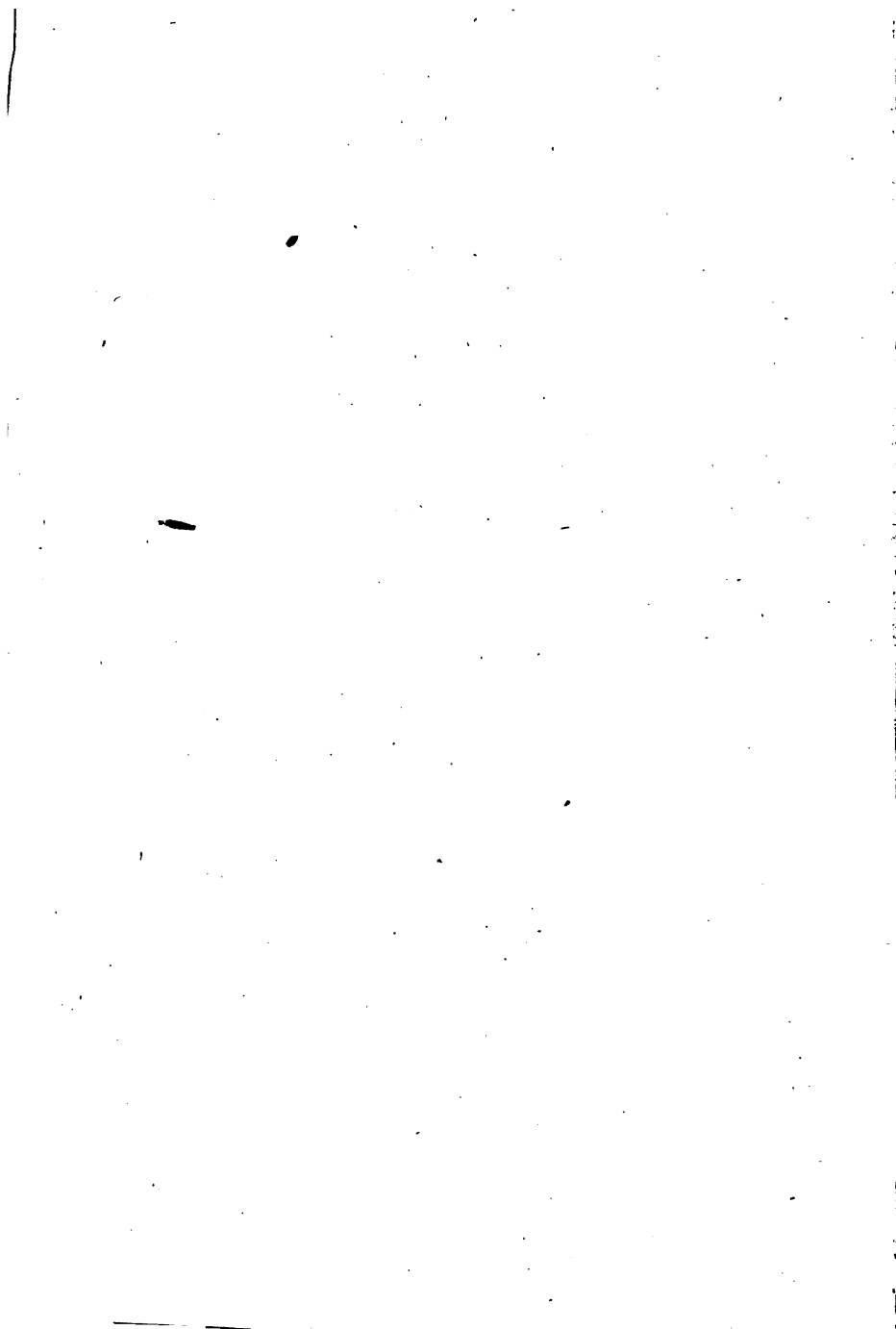
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The first part of the paper discusses the importance of the research and the objectives of the study. It then presents a literature review of the existing research on the topic. The second part of the paper describes the methodology used in the study, including the data collection and analysis techniques. The third part of the paper presents the results of the study, and the fourth part discusses the implications of the findings. The paper concludes with a summary of the main findings and a discussion of the limitations of the study.

The research was conducted in a laboratory setting, and the data was collected using a series of experiments. The results of the experiments were analyzed using statistical methods, and the findings were compared to the results of previous studies. The study found that there is a significant relationship between the variables being studied, and the results have important implications for the field of research.

The study was limited by a number of factors, including the sample size and the experimental design. However, the findings provide a valuable contribution to the understanding of the topic, and further research is needed to confirm and extend the results.



THE PREVENTION
OF
FACTORY ACCIDENTS

THE PREVENTION OF FACTORY ACCIDENTS

BEING AN ACCOUNT OF MANUFACTURING INDUSTRY AND ACCIDENT
AND A PRACTICAL GUIDE TO THE LAW ON THE
SAFE-GUARDING, SAFE-WORKING, AND SAFE-CONSTRUCTION
OF FACTORY MACHINERY, PLANT AND PREMISES

WITH 20 TABLES AND 124 ILLUSTRATIONS

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PREFACE.

DURING an engineering experience of seventeen years, the latter portion of which has been devoted to the work of factory inspection, the attention of the author has been frequently drawn to the entire absence of any literature dealing with the practical aspects of industrial accident prevention, the statutory obligations regarding which are now so onerous, and concern all users of mechanical power.

In the first portion of the present work the statistics of such casualties in the industries in which they occur are set forth in tabular form and discussed, while the civil obligations of employers are described. In the third portion the factory law on the subject of accident and safety is collected for the first time from the various statutes: the repealed portions have been eliminated, and the rest arranged topically to read as a

whole. In the main portion of the work the author has endeavoured in a series of specially drawn illustrations to bring into relief the various devices which he has found to be of service in accident prevention. An index dealing specially with the practical features has been added for ready reference.

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PART I.

MANUFACTURING INDUSTRY AND ACCIDENT.

INTRODUCTION.

IN the first portion of this work some account is given of the numerous establishments in which the manufacturing industries of the country are carried on, and of the accidents occurring therein, and the statutory provision for their notification, prevention, and compensation.

The relative extent of such employments and of the individual concerns is generally inferred from statistical returns of their production and its estimated value.

For the present purpose however we require to consider the factories and workshops of Great Britain and Ireland in relation to the number of persons employed, their age, sex, and distribution amongst the trades. This is done in Chapter I., where the industries are also tabulated and classified in order of magnitude.

The extent of industrial accident, its degree, seasonal distribution, and relation to the age, sex, and occupation of the injured persons call for notice and occupy Chapter II., where, in a series of Tables and Charts, its salient features are presented.

For the guidance of occupiers of factories and workshops, employees, and other interested persons, some account of the Factory Act requirements in relation to

the occurrence of accident and a descriptive summary of the safety provisions of the same statutes are given in Chapter III.

The employer's liability and the workman's remedies for accident are described in Chapter IV., and detailed so far as they are maintained by actions at law.

The important and far-reaching addition to the law of reparation, embodied in the Workmen's Compensation Act, 1897, has been discussed at length in Chapter V. Some attempt has also been made to estimate the respective liability to fatal and serious accident in the most dangerous trade groups, and the result of a year's operation of the Act is described.

The present portion of the work closes with an account in Chapter VI. of the causes of factory accident, their trade distribution and relative importance.

CHAPTER I.

FACTORY INDUSTRIES.

Definition.—The premises subject to the general factory law contained in the statutes dating from 1878 to 1895 are either factories or workshops, and for convenience of reference the precise terms of the statutory definition of such places is given in Part III. of this work.

For practical purposes however, relating to the law on accidents and safety, an equally accurate but more succinct definition may be here adopted. The expression “Factory” comprises all premises in which are carried on any of the eighteen industries named and defined in Part I. of the schedule on page 284 of this work, whether mechanical power is used or not, and any premises wherein, or within the close or curtilage or precincts of which, any manual labour is exercised by way of trade or for purposes of gain in or incidental to the following purposes, or any of them; that is to say—

- (a) In or incidental to the making of any article or part of any article; or,
- (b) In or incidental to the altering, repairing, ornamenting, or finishing of any article; or,
- (c) In or incidental to the adapting for sale of any article,

and wherein, or within the close or curtilage or precincts of which, steam, water, or other mechanical power is used in aid of the manufacturing process carried on there.

The words "mechanical power" embrace all the known prime movers; namely, steam, gas, oil, hydraulic and other engines, waterwheels, turbines, windmills, and electric motors; they do not, however, apply to power derived from manual or animal exertions.

Factories in which any machinery is used to prepare, manufacture, finish, or perform any process incident to the manufacture of cotton, wool, hair, silk, flax, hemp, jute, tow, china-grass, cocoa-nut fibre, or other like fibrous material are classified as *Textile Factories*, and a small proportion of workshops are also engaged in textile operations. The great bulk of the manufacturing industries of the United Kingdom are, however, carried on in non-textile factories and workshops.

The expression "Workshop" means any of the seven classes of premises, not being factories, named in Part II. of the schedule on page 286 of this work, and also any premises, room, or place, not being a factory, in which manual labour is exercised by way of trade or for purposes of gain in or incidental to the purposes already defined; "Workshops," other than bakehouses, employing men only, being exempt from the general law except for accident notification and investigation and other limited purposes.

It will therefore be seen that, apart from the eighteen exceptions already referred to, the broad line of distinction between factories and workshops is the presence or absence of mechanical power.

Registration.—The ordinary Factories and Workshops just described, the workshops which employ men only, and all laundries under the Acts are brought to the knowledge of Her Majesty's Inspectors by a statutory system of registration. Every person, within one month after he begins to occupy a factory, workshop, men's

workshop, or laundry, must serve upon the Inspector for the district a notice containing the particulars prescribed by the Acts, and, in default, is liable to a fine not exceeding five pounds. The following table, No. 1, contains a notification of the occupation of a factory in the form prescribed by the Secretary of State:—

TABLE I.

FACTORY AND WORKSHOP ACTS, 1878 TO 1895.
BEGINNING TO OCCUPY A FACTORY OR WORKSHOP.

NOTICE.

I hereby give notice that I have begun to occupy a Factory (or Workshop) as under mentioned:—

Name of the firm
under which the
business is carried } Peter Anderson.
on

Name of the Factory
(or Workshop) . } Harbour Saw Mills.

Place where the Fac-
tory (or Work-
shop) is situate . } 16 High Street, Wick, Caithness.

Address to which
letters are to be } Do. Do.
addressed . . . }

Nature of the work . Sawing and Dressing of Timber.

Nature and amount
of moving power . } One Steam Engine of 70 Horse-power.

Signature of Occupier. PETER ANDERSON.

Date—1st January, 1898.

To

H.M. INSPECTOR OF FACTORIES AND WORKSHOPS.

This Notice is in the Form prescribed by the Secretary of State, and must be served on the Inspector for the district.

Number of Employers.—In those industries of the United Kingdom of which statistics are extant there are 250,000 premises classified for various purposes as Factories and Workshops under the Factory Acts, 1878 to 1895. Of this total, 221,000 are, under the principal Act of 1878, Factories and Workshops as already defined, and subject generally to these statutes, and 6800 are Laundries, with and without mechanical power, brought by the Act of 1895 under certain of the regulations, including those on accidents and safety. The remainder, included under the word "Factory" for limited purposes by the Act of 1895, is composed of 1700 Docks, Wharves, and Quays, and 3500 Warehouses, subject to the accident clauses, and such provisions as to safety as may be prescribed by Statutory Special Rules and Orders, and 17,000 Workshops, employing men only, which are required to notify accidents, and formal investigation into the latter may be made.

Certain employments, of which no statistics exist, are, in addition to the quarter of a million premises just detailed, included in the word "Factory" by the Act of 1895. In these the accident clauses and such provisions as to safety as may be prescribed by Statutory Special Rules and Orders are applicable to any premises on which machinery worked by steam, water, or other mechanical power is temporarily used for the purpose of the construction of a building or any structural work in connection with a building. While the provisions of the Acts with respect to notice of accident and the formal investigation of accident take effect as if any building which exceeds thirty feet in height, and which is being constructed or repaired by means of scaffolding; and any building which exceeds thirty feet in height and in which more than twenty persons, not being domestic

servants, are employed for wages, were included in the word "Factory". The result of the three latter inclusions has been to add indefinitely but yet considerably to the number of employments and persons to whom the accident and safety clauses of the Factory Acts more or less apply, though, on the other hand, the reported accidents from such places are comparatively few.

Of the 221,000 Factories and Workshops proper, and separate branches of such, under the Factory Act of 1878, 94,000 are Factories, and 127,000 are Workshops. The Textile Factories, 10,000 in number, employ an average of 108 persons and are relatively large. In the non-Textile Factories, numbering 84,000, the bulk of the power industries of the United Kingdom are carried on, and an average of thirty-five persons is employed, the actual numbers for individual factories, however, ranging from 1 to 4000 persons.

Number of Persons Employed. — The statistics of persons, to whom the accident regulations of the Factory Acts apply, are available only in the case of Factories and Workshops proper, to which alone the statutory provision for an annual return of persons employed applies.

In the 221,000 Factories and Workshops in the United Kingdom about four and a half millions of men, women, young persons, and children are engaged. These are distributed amongst the various classes of works and throughout the country as shown in Table II., where the actual numbers, since considerably increased, for the year 1896 are given.

The characteristics of these annual returns are a steady decrease in the number of children employed as half-timers, a comparatively stationary total of persons employed in Textile Factories, and a very considerable

TABLE II.

GENERAL SUMMARY OF PERSONS EMPLOYED IN FACTORIES AND WORKSHOPS IN 1896.										
Classes of Works.	Registered Factories or Work- shops or Depart- ments.	Children (11-14) employed as Half-timers.		Persons under 18 years of age em- ployed as Full Timers.		Persons above 18 years of age.		Total number of Persons employed.		
		Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males and Females.
Textile Factories.										
England and Wales	8,422	19,922	23,423	67,737	123,445	256,788	365,346	344,447	512,214	856,661
Scotland . . .	1,114	2,186	2,875	8,841	22,258	32,522	78,672	43,549	103,805	147,354
Ireland . . .	415	2,194	2,656	5,805	8,159	16,846	38,012	24,845	48,827	73,672
United Kingdom .	9,951	24,302	28,954	82,383	153,862	306,156	482,030	412,841	664,846	1,077,687
Non-Textile Factories.										
England and Wales	59,791	4,434	1,828	258,918	109,416	1,550,708	267,785	1,814,060	379,029	2,193,089
Scotland . . .	7,190	542	247	35,549	19,321	260,635	47,149	296,726	66,717	363,443
Ireland . . .	4,278	116	74	7,443	5,855	68,688	27,023	76,247	32,952	109,199
United Kingdom .	71,259	5,092	2,149	301,910	134,592	1,880,031	341,957	2,187,033	478,698	2,665,731
Workshops.										
England and Wales	71,245	1,256	1,113	53,470	83,349	194,877	187,748	249,603	272,210	521,813
Scotland . . .	10,846	225	359	7,262	11,498	32,549	47,792	30,036	59,649	99,685
Ireland . . .	5,202	63	100	3,187	5,216	10,561	14,940	13,811	20,256	34,067
United Kingdom .	87,293	1,544	1,572	63,919	100,063	237,987	250,480	303,450	352,115	655,565
Grand total of all Works in the United Kingdom . . .										
	168,503	30,938	32,675	448,212	388,517	2,424,174	1,074,467	2,903,324	1,495,659	4,398,983

growth in the total for workshops, and particularly for Non-textile Factories, which, through the perfecting of the oil engine, have greatly increased in areas where fuel is scarce and gas cannot be cheaply manufactured. In 1896, compared with 1895, an increase of nearly 6000 took place in the number of Non-textile Factories, with a corresponding addition to the persons employed of nearly 200,000. More than half of the total increase occurred in the Engineering trades.

The proportion of males to females in the grand total of persons employed in all Factories and Workshops is two to one. Females predominate in the Textile and Workshop divisions, but males are more than four and a half times as numerous in the non-textile factories, which employ 60 per cent. of the total workers.

The Number and Classification of Manufacturing Industries demand attention in connection with the subject of Factories and Accidents. The four and a half millions of persons employed in the Factories and Workshops of the United Kingdom are distributed amongst 150 industries. With the object of showing the relative importance of the various trades the latter have been classified as Textile and Non-textile, and grouped in Tables III. and IV. in the order of number of persons employed.

Textile Industries.—The Textile industries employ 25 per cent. of the total operatives, chiefly in Factories, and fall naturally into thirteen divisions when classified according to the fibrous material operated upon.

From Table III. it will be seen that one-half of the total Textile workers are employed in the Cotton industry, one-fourth in the Worsted and Wool, and about one-eighth in the Flax and Jute manufactures, while the remainder are engaged principally in the Hosiery, Silk, Lace, Hemp, and Shoddy Industries. The average

Cotton and Worsted Factories approximate in size, but premises in the Wool industry are, as a rule, only about a fourth of the former in extent; while Flax and Jute Works employ on an average the largest number of textile workers per factory. According to the last Statutory Return (Table II.) 53,256 children were employed as half-timers in textile industries. Of these 55 per cent. were engaged in the Cotton trade, 24 per cent. at Worsted, Wool, and Shoddy, and 17 per cent. at Flax, Hemp, and Jute manufactures.

TABLE III.

TEXTILE INDUSTRIES OF THE UNITED KINGDOM IN ORDER OF NUMBER OF PERSONS EMPLOYED.		
Industry carried on in the Factory.	Number of Factories.	Number of Persons employed.
I. Cotton	3,157	532,920
II. Worsted	991	142,450
III. Wool	3,200	131,685
IV. Flax	435	108,871
V. Jute	183	43,008
VI. Hosiery	369	35,952
VII. Silk	573	35,850
VIII. Lace	414	17,088
IX. Hemp	130	10,584
X. Shoddy	361	10,306
XI. Elastic	55	4,473
XII. Cocoa-nut Fibre	36	2,453
XIII. Horse-hair	47	2,047
Total Factories	9,951	1,077,687
„ Workshops (all branches)	1,383	14,672
Grand Total	11,334	1,092,359

The geographical distribution of the principal textile

industries is interesting. Seventy-eight per cent. of the Cotton operatives are employed in Lancashire, 12 per cent. in the Counties of Chester and York (West Riding), and 5 per cent. in Lanark and Derby shires. Yorkshire (West Riding) is the seat of the Wool, Worsted, and Shoddy trades, 72 per cent. of the operatives in such factories being employed in that district, $10\frac{1}{2}$ per cent. in Lancashire and Worcestershire, and the remainder is very generally distributed throughout the Kingdom, hardly a county being unrepresented. The third main textile group, Flax, Hemp, and Jute, is to be found mainly in the Counties of Forfar and Fife with 39 per cent., and Antrim, Armagh, and Down with 37 per cent. of the total employees, while Aberdeen, Lancaster, and York (West Riding) have 8 per cent. distributed about equally between them. Of the three remaining important Textiles, Hosiery has 51 per cent. employed in Leicestershire and 20 per cent. in Nottinghamshire. Silk occupies 49 per cent. of its total in the Counties of Chester and York (West Riding); while the Lace industry has 50 per cent. of its factory operatives in Nottinghamshire, 28 per cent. in Derbyshire, and 10 per cent. in Ayrshire. The total number of persons employed in textile operations in the United Kingdom has been practically stationary for the last fifteen years, although variations have occurred meanwhile in the individual industries.

Non-Textile Industries.—Three-fourths of the manufacturing operatives of the United Kingdom are employed in Factories and Workshops dealing with non-textile materials and products. It is in this section that trade expansion is found, the elasticity of the non-textile factory branch being very remarkable. In 1896 the number of persons employed in the latter increased by 185,612—

TABLE IV.
NON-TEXTILE INDUSTRIES OF THE UNITED KINGDOM IN ORDER OF NUMBER OF PERSONS EMPLOYED.

Industry carried on in the Factory or Workshop.	Factories.		Workshops.		Factories and Workshops.		Percentage of Non-Textile Total.
	Number of Occupiers.	Number of Persons employed.	Number of Occupiers.	Number of Persons employed.	Number of Persons employed.		
I. Clothing (Boots, dresses, tailoring)	2,296	228,064	48,902	338,536	566,600	17.13	54.82
II. Machines, Engines, Boilers, Smiths	6,587	447,958	1,735	9,409	457,367	13.83	
III. Appliances, Conveyances, Tools (Coaches, saddlery, cycles, vehicles, files, saws, cutlery, metal instruments, tubes, wire chains, nails, small arms, ordnance, etc.)	6,035	232,902	6,688	45,865	278,767	8.43	
IV. Metals: founding and conversion of (Mixing and casting, iron and steel milling, etc.)	4,075	261,397	10	33	261,430	7.91	7.52
V. Printing, Paper, Stationery (Paper, ink, binding, ruling, litho., photos, type founding, envelopes, boxes, other stationery)	9,942	238,269	1,055	10,427	248,696	7.52	
VI. Food (Bread, confectionery, cereals, cocoa, preserved meats, fruits, fish, salt and other foods)	10,040	130,530	9,688	68,526	199,056	6.0	5.81
VII. Miscellaneous Articles (Barrels, ropes, sails, brushes, glue, firewood, fustian cutting, rag working, and articles of stone, wood, leather, metal, paper, etc.)	4,290	135,517	5,657	56,551	192,068	5.81	
VIII. Print, Bleach, and Dye Works (Calico, other print works, bleaching, cleaning, dyeing, calendering, finishing, packing)	2,638	138,769	36	193	138,962	4.21	24.22
IX. Stone and Clay (Claypits under 20 feet, marble and stone cutting, lime, cement, bricks, earthenware)	3,360	125,271	1,185	10,573	135,844	4.10	4.08
X. Ship and Boat Building	522	132,465	243	2,504	134,969	4.08	

XI. Wood (Sawmills and carpenters)	6,196	93,141	2,835	16,327	109,968	3-32
XII. Furniture (Cabinet, household furniture, upholstery)	2,137	52,306	4,197	41,547	93,853	2-83
XIII. Chemicals (Alkali, bichromate, lead, salts, paints, colours, varnish, matches, soap, candles, oils, oil-cake, manures, dyes, drugs, etc.)	2,261	88,814	312	3,105	91,919	2-78
XIV. Drink (Brewing, malting, distilling, beer bottling, aerated waters, other drinks)	4,942	82,359	366	2,997	85,356	2-58
XV. Jewellery, Plate, Fancy Articles, Fine Instruments, Games	1,205	46,196	2,499	26,744	72,940	2-21
XVI. Gas	635	51,702	6	33	51,735	1-60
XVII. Metals: extraction of	320	34,138			34,138	1-03
XVIII. Leather (All smelting processes)	892	29,927	131	1,614	31,541	-95
XIX. Glass (Tanners, fell-mongers, curriers)	429	29,758	107	1,152	30,910	-93
XX. Tobacco, Snuff and Cigars	477	28,331			28,331	-85
XXI. Metals: Galvanising, Finishing, etc. (Enamelling of iron and hollowware, galvanising, corrugating, brass finishing)	533	18,909	118	1,716	20,625	-62
XXII. India-rubber and Gutta-percha	139	18,627	66	1,353	19,980	-61
XXIII. Explosives (Gunpowder, di-nitro-benzole, and other explosives, percussion caps, cartridges)	69	10,735	12	282	11,017	-33
XXIV. Flax Scutching	753	4,745			4,745	-14
XXV. Electricity: Generation of	376	3,329	4	18	3,347	-10
XXVI. Ivory, Bone, Shell and Jet	110	1,572	78	888	2,460	-07
Total	71,259	2,665,731	85,910	640,893	3,306,624	100

13-72

7-24

7 per cent.—while textile factories contributed the comparatively trifling increase of 1936 and workshop employees increased by 7950 persons.

The non-textile trades can only be classified arbitrarily, but their nature and extent can be concisely and sufficiently indicated by grouping them in twenty-six divisions in the order of the number of persons employed and indicating the branches included under each of these as in Table IV. Twelve of the divisions are named from the materials operated upon, thirteen from the nature or purpose of the products, and the remaining division constitutes a group of miscellaneous articles.

The Clothing industry stands first in point of number of operatives, employing as it does about 13 per cent. of the total manufacturing population and 17·13 per cent. of the non-textile workers in 51,198 premises, mostly small workshops. The clothing factories though numbering only 2296 are comparatively large and employ an average of 100 persons in each. In such factories 60 per cent. and in the workshops 73 per cent. of the operatives are females.

Metal industries occupy the next three positions. Second in the Kingdom in point of numbers employed but first in importance are the Machinery, Engine, Boiler and Smith-work trades which employ 450,422 males—98 per cent.—and afford work to 13·83 per cent. of the non-textile operatives of the country, and to 20 per cent. of the males so engaged. Only 2 per cent. of the workers in this group are found in workshops. The group of industries classified under Appliances, Conveyances and Tools comes third in order and employs 213,039 males—76 per cent.—but a larger proportion of the work is carried on without mechanical power, 14 per cent. of the operatives being found in workshops. The

fourth group, the Founding and Conversion of the various metals, is practically a factory industry in which 96 per cent. of the employees are males.

The five largest divisions of non-textile industries together employ 54·82 per cent. of the operatives in such factories and workshops and in the fifth in order, the Printing, Paper, and Stationery Trades, male labour again predominates, only 30 per cent. of the employees being females.

At the second group of five trades—Food, Miscellaneous Articles, Bleaching and Dyeing, Stone and Shipbuilding—24·22 per cent. of the non-textile operatives are engaged. In the first pair of these divisions, Nos. VI. and VII., the proportion of males to females is almost two to one; in the second pair, Nos. VIII. and IX., it is three to one, while in Shipbuilding males comprise 99½ per cent. of the employees and the individual factories in that industry have on an average the largest number of non-textile workers.

Wood, Furniture, Chemicals, Drink, and Jewellery, etc., constitute a third group of five divisions and account for 13·72 per cent. of the non-textile total. The percentage of males in each of these divisions is 99, 79·8, 86·6, 93·5 and 60 respectively.

The remaining group consists of eleven divisions employing altogether but 7·24 per cent. of the non-textile trades total, and of these, Gas, Metal Extraction and Electricity are practically confined to males. The percentages of males in the remainder are, Leather 95·3, Glass 91·5, Tobacco 30, Metal Finishing 84·9, India-rubber 58·7, Explosives 60·6, Flax Scutching 65, Ivory 61. Geographically the non-textile industries are much more widely distributed than the textiles, shipbuilding, however, is naturally confined to the principal ports, the

extraction of metals to ore and fuel producing districts, flax scutching to Ireland, and jet working to England.

Premises not Factories or Workshops.—No statistics are extant as to the number of persons who work or have traffic about the Docks, Wharves, Quays, Buildings and Laundries brought under the accident regulations by the Factory Act of 1895, but from Table V. some idea of the number of such premises may be obtained.

TABLE V.

PREMISES NOT FACTORIES OR WORKSHOPS BUT UNDER THE FACTORY ACTS FOR ACCIDENT REPORTING, ETC.		
Factory Act 1895.	Nature of Premises.	Number of Premises.
Section 18	Workshops employing men only	(estimated) 17,000
Section 22	Laundries with mechanical power	1,401
	Laundries with no mechanical power	5,359
Section 23	Docks, Wharves and Quays	1,751
	Warehouses	3,812
	Buildings — Construction, Repair, Demolition	Numbers variable and not ascertainable.
	Buildings, occupation of, over 30 feet high	

CHAPTER II.

FACTORY ACCIDENTS.

A Year's Accidents.—The importance of the subject of the Prevention of Accident may be gauged from the fact that in the peaceful pursuit of industry throughout the United Kingdom during 1898, 3897 persons were killed and 79,727 more or less injured, a casualty list far exceeding that of several great campaigns. Of these accidents 57,562 fell within the scope of the Factory Acts. The comparative immunity from accident of about 700,000 Workshop employees, compared with their fellows in Factories with power-driven machinery and dangerous plant, is shown by the fact that only eighty persons were injured in the former during 1897, three fatally and the others very slightly, and the returns for 1898 show only two fatalities in Workshops and 137 minor injuries. The accident statistics, comparisons and rates which are given in this work are, in consequence, for greater usefulness and accuracy, restricted to Factory employment.

Degree of Injury.—A detailed statement is given in Table VI. of the age and sex of the persons reported as killed and injured in Factories during 1898. The degree of injury is indicated also in the cases where the cause of injury required a notification to the certifying Surgeons, as well as to Inspectors.

In 1898 out of the 57,423 accidents which occurred in Factories, 38,199 were not due to machinery in motion

TABLE VI.
REPORTED ACCIDENTS IN FACTORIES, 1898.
CLASSIFIED ACCORDING TO DEGREE OF INJURY, AGE, AND SEX.

Degree of Injury.	Adults (over 18).		Young persons (14-18).		Children (11-14).		All ages.		Total. Males and Females.
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	
All reported Accidents in Factories	44,533	1998	9180	1405	224	83	53,937	3486	57,423
Accidents notifiable to Inspectors only	39,922	500	4394	291	63	29	37,379	820	38,199
Analysis of the accidents notifiable to certifying Surgeons as well as to Inspectors:—									
Causing death	620	5	89	5	6	...	715	10	725
Loss of right hand or arm	29	5	17	6	...	...	46	11	57
Loss of left hand or arm	38	4	23	5	1	...	62	9	71
Loss of part of right hand	602	140	373	114	18	5	993	259	1,252
Loss of part of left hand	664	81	280	90	12	3	956	174	1,130
Loss of any part of leg or foot	56	...	12	2	...	...	68	2	70
Fracture of limbs or bones of trunk	353	26	187	15	4	1	544	42	586
Fracture of hand or foot	310	45	143	36	4	...	457	81	538
Loss of sight of one or both eyes	38	3	5	2	...	...	43	10	53
Injuries to head and face	849	154	261	66	7	8	1117	228	1,345
Burns and scalds	1708	39	327	23	3	2	2038	64	2,102
Lacerations, Contusions, and other injuries not enumerated above	6344	991	3069	750	106	35	9519	1776	11,295
Total of accidents notifiable to certifying Surgeons as well as to Inspectors	11,611	1498	4786	1114	161	54	16,558	2666	19,224

by mechanical power or other causes requiring reports to the certifying Surgeons, and many of these were comparatively slight.

A balance, however, of 19,224 cases remains, in 725 of which the persons were killed, and the others resulted in more or less serious injury. Of the latter, 128 persons lost arms or hands, 2382 parts of hands or fingers, seventy parts of legs or feet, 1124 sustained fractured bones, fifty-three the loss of sight in one or both eyes, 2102 burns and scalds, while the remaining 11,295 persons suffered chiefly from lacerations and contusions.

Distribution according to Age and Sex.—The distribution of Industrial accidents according to age and sex is instructive. It is frequently assumed that the liability to accident naturally follows the course of the Factory Act limitations upon labour in the order of—children (11-14), young persons (14-18), women, men. Comparing Tables II. and VI., however, the actual order in the case of fatalities in Factories is found to be that of men, male young persons, male children, female children, female young persons, women.

In 1897 one man in 4000 was killed in factories, one male young person in 5500, one male child in 10,000, one female child in 30,000, one female young person in 72,000, and one woman in 100,000.

In the same year in non-fatal Factory accidents of varying degrees of seriousness, one man in seventy was injured, one male child in 160, one male and one female young person in 240, one female child in 410, and one woman in 500.

It will thus be seen that the risks run by males in general, and particularly by men, are much greater than in the case of females. The latter, as a rule, have fixed workplaces, and the work prescribed for them is usually

6. Chemicals	28	1,285	...	20	3	153	...	15	...	1	...	...	31	1,474	1,505
7. Wood : sawmills and carpenters	13	1,129	...	10	3	317	...	22	...	1	...	...	16	1,479	1,495
8. Miscellaneous articles	15	715	...	77	...	214	1	68	...	7	...	2	16	1,083	1,099
9. Glass	12	624	1	16	...	185	...	4	13	...	...	2	13	844	857
10. Food	18	531	...	97	3	125	1	62	...	...	...	...	22	815	837
11. Metal extraction	31	702	...	2	2	50	...	...	...	...	...	...	33	754	787
12. Gas	15	752	...	...	1	7	...	...	...	...	...	...	16	759	775
13. Drink	12	487	1	76	1	107	...	7	...	...	...	...	14	677	691
14. Print, bleach, and dye works	12	394	...	18	8	163	...	14	1	9	...	1	21	599	620
15. Metal galvanising	2	309	...	38	...	140	...	35	...	...	...	...	2	522	524
16. Clay and stone working	23	295	...	14	3	115	...	6	1	2	...	1	27	433	460
17. Clothing	2	172	...	54	1	185	...	38	...	2	...	...	3	451	454
18. Other Non-Textiles (Divisions XII., XV., XVIII., XX., and XXII. to XXVI. in Table IV., Chap. I.)	13	793	...	60	...	232	1	36	...	3	...	1	14	1,125	1,139
Total Non-Textile	499	35,018	2	706	68	7850	3	560	4	62	...	9	516	44,205	44,721
FACTORY ACT, 1895.															
<i>Employment at—</i>															
1. Docks, wharves, quays	87	3,994	...	3	2	73	...	...	...	...	...	...	89	4,070	4,159
2. Warehouses	13	2,358	...	1	2	143	...	1	4	...	...	1	16	2,507	2,523
3. Building, construction and repair	38	434	...	...	4	18	...	...	...	...	...	...	42	452	494
4. Laundries using mechanical power . . . . .	...	39	...	107	...	8	...	61	...	...	...	...	...	215	215
5. Buildings in use	3	141	...	7	...	15	...	1	...	...	...	...	3	164	167
Total 1895 Act employments	141	6,966	...	118	8	257	...	62	1	4	...	1	150	7,408	7,558
Grand Total	620	43,913	5	1993	89	9091	5	1400	6	218	...	83	725	56,698	57,423

of a definite and limited range at the floor level, in which the same operations are repeated *ad infinitum*. In such cases almost all the risks can be met by attention to the statutory safe-guarding and care. In the case of males, however, who form 60 per cent. of the whole employees in Factories, the area of risk is much extended, both male young persons and male children being engaged at more dangerous operations than females of the corresponding age; while men, who form 58 per cent. of the Factory workers, have to approach prime movers, mill gearing, and other machinery in motion, and require to perform difficult and dangerous tasks on ladders, narrow platforms and temporary staging.

From the table it will be seen that in 1898 98 per cent. of all the fatalities in factories occurred to males and 86 per cent. of the former was sustained by male adults. Of the non-fatal injuries notified from factories to certifying Surgeons, 86 per cent. occurred to males and the corresponding proportion in accidents reported to Inspectors only was 98; while of this injury to males no less than 70 and 88 per cent. respectively was sustained by men.

Distribution according to Industries.—In Table VII. the accidents in Factories during 1898 are classified according to Industry, Result, Age, and Sex, and arranged in the order of accident totals.

Textiles.—Amongst this class of factories during 1898 it will be observed that Cotton stands highest both with regard to fatal and non-fatal accident, claiming 59·3 per cent. of the deaths and 62·5 per cent. of the non-fatal injury.

On comparing Tables III. and VII., it will be seen that in Textiles the accident totals follow the order of number of persons employed, except in the case of Jute,

which, though it has only 39·5 per cent. of the operatives engaged upon Flax, is a more dangerous manufacture and takes precedence of the latter in the number of both fatal and non-fatal injuries. It will also be noted that, though the total accidents in Worsted are higher than those in Wool, the fatal cases in the latter are more numerous.

Non-Textiles.—In the non-textile factory industries the order of number of persons employed has no general relation to the total casualties, the nature of the industry being the determining factor.

Engineering, Shipbuilding, Appliance making, and Metal founding and conversion are four great non-textile industries which head the accident totals in that division of Table VII. Though these trades collectively employ only 43 per cent. of the total of such factory workers, they claimed in 1898 no less than 71·4 per cent. of all the non-textile casualties as well as 51 per cent. of such of these as resulted in death, and are rightly regarded as amongst the most dangerous occupations.

The next four trades in the Table—Nos. 5, 6, 7 and 8—employ 20·8 per cent. of the non-textile factory operatives, and last year contributed 12·6 per cent. of the accident to such workers. The remaining 16 per cent. is distributed in the manner indicated in the table amongst the factories in the ten industrial groups—Nos. 9 to 18—which together employ 36·2 per cent. of the total factory employees in the non-textile section.

When the number of operatives engaged in each factory industry is taken into account the first four non-textile occupations in Table VII., together with Wood and Metal Extraction—Nos. 7 and 11—are found to have the highest accident rates of any class of textile or non-textile factory; the order of danger from the non-fatal

injuries reported to certifying Surgeons being (1) Wood, (2) Engineering, (3) Appliances, (4) Metal extraction, (5) Metal founding and conversion, and (6) Shipbuilding.

In Table No. XVII., Chapter V., Accident Rates in three classes of injury are given for each of the twenty-four ordinary factory industries just discussed.

Employments under 1895 Act. The last five occupations in Table VII. are those in which accidents were reportable for the first time in 1896, under the Act of the previous year. With the exception of factory laundries, in which the serious accident risk is very low, the outstanding feature of this class of industrial casualty—which is distributed over a large but unknown population—is the high ratio which the fatalities in several of the employments bear to the total accidents. During 1898 in Building operations by mechanical power and by scaffolding at premises over thirty feet in height one injury in twelve proved fatal, at Dock, Wharf, and Quay labour one in forty-six, at Buildings in use with more than twenty persons, other than domestics, one in fifty-six.

This result is largely due to the character of the accident risk, falls of persons, of structures, tools, and material accounting for 90, 70 and 66 per cent. respectively of the mortality.

Distribution throughout the Year.—The seasonal distribution of Factory Accidents is interesting and instructive. In Table VIII. a chart is given of the fatal accidents reported per month for each of the years 1896 to 1898.

From the chart it will be seen that fatal accidents have usually been at a minimum during the month of August; have rapidly increased during the months of diminishing light and have reached their maximum

during the last two years in the month of December from which point they have gradually declined again. The 1898 chart, while exhibiting generally these characteristics, shows a lower accident total for the first seven months of the year than those for 1897 and 1896 and has its minimum in July.

The influence of the exceptional increase in accident mortality, particularly the forty-one deaths in the Trade Groups IX. to XVIII. in Table VI., is revealed during the last six months of 1898 in the chart by a sharp rise and

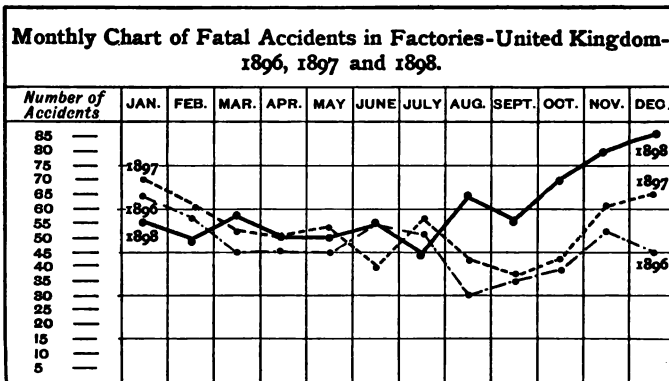


TABLE VIII.

unusually high death-rate in August, the increase being maintained to the close of the year, in the last month of which no fewer than thirty deaths from this group were contributed to the December total of eighty-five fatal accidents.

In Table IX. Charts of Factory Accidents in general and of the fatal and more serious injuries combined are given for the years 1896 to 1898. In the case of the latter chart the maximum has generally been reached between October and November after rising from a

minimum in August, with considerable fluctuation above and below the mean during the first six months of each year.

For 1898 this chart repeats the characteristics of that for fatal accidents in the same year in Table VIII., the volume of all accidents in August being much greater than usual and the increase being steadily maintained till the month of November.

Accident Increase.— From inspection of the upper charts of Table IX. representing the monthly totals of all classes of accident reportable to H.M. Inspectors, it will be seen that, though the all-accident charts for 1896 and 1897 exhibit the same general characteristics as the corresponding lower charts dealing only with accidents requiring a report to certifying Surgeons, the upper chart for 1898 reveals a volume of accidents throughout the year and particularly during the last six months out of all proportion to the increases found in the fatal chart in Table VIII. and the combined fatal and serious accident chart for the same year in Table IX.

This phenomenal record is due to several causes. From 1878 to 1896 the casualties requiring to be reported were all fatalities, and the accidents preventing a return to work within forty-eight hours after the occurrence which arose from Power Machinery, Vats, Pans, Explosions, and Escape of Gas, Metal, or Steam.

From 1896 onward this standard was much lowered by the Act of 1895, the causation standard being adhered to for the purpose of Reports sent to certifying Surgeons, though the time limit of absence from work was reduced to inability to perform five hours' ordinary work on any one of the next three days after the occurrence, and, in addition, the previously non-reportable but large class of non-fatal accidents occurring from causes other than

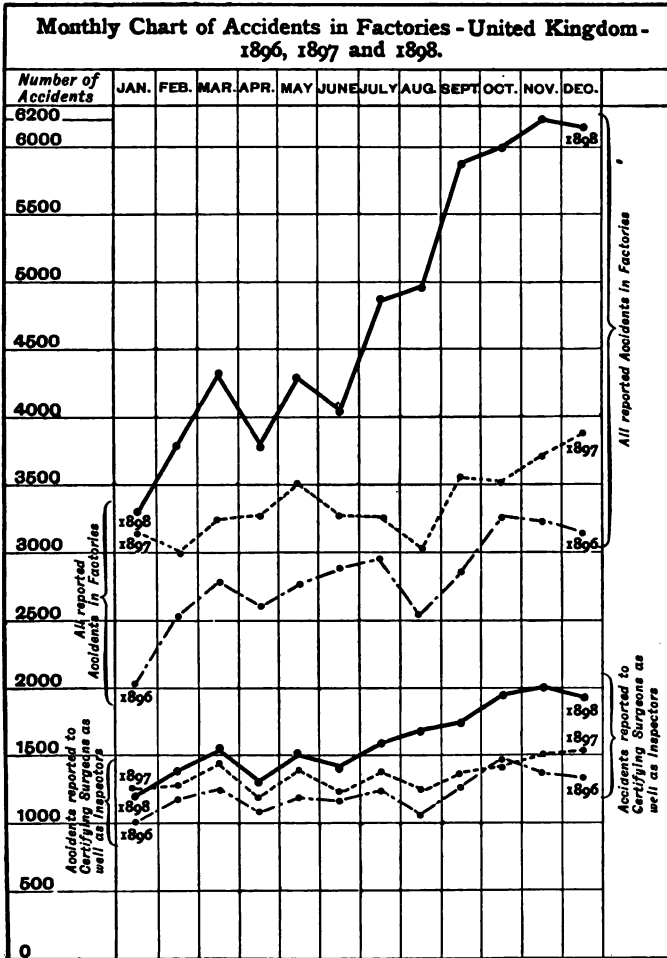


TABLE IX.

those specified and causing the same brief absence from work were made reportable to H.M. Inspectors only. The net effect of the new regulation was to distinguish between three classes of accident, namely: (1) Fatal injuries, (2) injuries from the above-named causes, most of which entail a much longer absence from work than the prescribed minimum; (3) injuries from all other causes, not a few of which entail a very brief absence from work. The investigation of the latter seldom serves any useful purpose as the cases in which prevention might be secured under the Statute are mostly included under (1) and (2). At the same time the degree of injury in a proportion of class (3), though always coming short of death, is considerable, particularly in the falls of persons, material, structures, and tools in the shipbuilding and metal converting and manufacturing works.

Though, in addition to Reports, the registration at each factory of these three classes of accident was required from 1st January, 1896, it was only very gradually that occupiers realised the bearing of the new accident standard upon casualties in their works.

Reports in class (3) in 1897 showed an increasing appreciation of the statutory requirements, and in 1898 a further advance towards accurate reporting of minor casualties was made. Owing to the low standard great difficulty was found in getting employees to notify class (3) of accident to occupiers, this was particularly felt in Engineering and Shipbuilding works and the metal trades generally with respect to piece workers who absented themselves for more than the prescribed time without assigning a slight accident as the cause. In one work the author found that the accidents reported per *month* rose, solely owing to this cause, from eleven to sixty-five.

From 1st July, 1898, and onward, the combined effect

of increased diligence on the part of occupiers, the regulations of insurance undertakers under the Workmen's Compensation Act, 1897, which only then came into force, and a greater willingness to report accidents upon the part of employees, led to the enormous increase in minor casualties which is represented by the ordinates between the two 1898 charts in Table IX. These causes also contributed to more accurate reporting in accident classes (1) and (2) particularly in the occupations brought under the Acts for accident purposes for the first time by the Act of 1895, namely, Laundries, Docks, Wharves, Quays, Warehouses, and certain classes of Buildings.

Viewing the chart results as a whole it will be seen that the great majority of accidents in class (3) should for practical purposes be left out of account in estimating the possibilities of preventive regulations. In calculating Accident Rates, however, with the Workmen's Compensation Act liability in view, some account must be taken of the degree of injury and resulting incapacity for work arising from such casualties, and this has been done in Chapter V. of the present work.

The amendment of the accident notification clause of the Factory Act of 1895 in the direction of a higher time limit, particularly for accidents from class (3) is inevitable, and the prescribing in the latter case of an absence from work of more than two weeks would ensure the retention of the few preventable casualties and at the same time indicate decisively the number from this class falling within the scope of the Compensation Act.

Trade and Sex Incidence of Accident Increase.—In Table X. a summary of the factory accidents, whose seasonal distribution and number have just been discussed, is given for the textile and non-textile factories

TABLE X.
REPORTED ACCIDENTS IN FACTORIES, 1896, 1897, AND 1898.
CLASSIFIED ACCORDING TO INDUSTRY, SEX, AND RESULT.

REPORTED ACCIDENTS IN FACTORIES, 1896, 1897, AND 1898.																
CLASSIFIED ACCORDING TO INDUSTRY, SEX, AND RESULT.																
Industry carried on in the Factory. (For trades included see same headings in Table IV.) F, Fatal; N, Non-fatal.	1896.				1897.						1898.					
	Males.		Males and Females.		Males.		Females.		Males and Females.		Males.		Females.		Males and Females.	
	F	F	F	F	F	N	F	N	F	N	F	N	F	N	F	N
TEXTILE.																
I. Cotton	25	27	16	1,547	2	1095	18	2,642	31	1,940	4	1293	35	3,179		
II. Worsted	5	5	3	305	...	242	3	547	6	366	1	268	7	634		
III. Wool	18	19	11	306	1	192	12	498	11	343	...	221	11	564		
IV. Jute	7	7	3	143	...	116	3	259	2	144	...	118	2	262		
V. Flax	7	...	4	119	1	85	2	204	1	128	...	94	1	222		
VI. Other Textiles	4	...	7	124	1	76	5	200	3	144	...	80	3	224		
(Divisions VI. to XIII., Table III., Chap. I.)																
Textile Total	66	69	38	2,544	5	1806	43	4,350	54	3,065	5	2020	59	5,085		
NON-TEXTILE.																
I. Machines, engines, boilers, smiths	56	56	63	6,815	...	8	63	6,823	88	11,841	...	10	88	11,851		
II. Ship and boat building . . .	75	75	64	5,192	...	1	64	5,193	70	7,834	...	...	70	7,834
III. Appliances, conveyances, tools .	20	1	21	3,278	...	134	21	3,412	30	6,078	...	204	30	6,282		
IV. Metal founding and conversion .	80	80	86	5,638	...	76	86	5,714	75	5,687	...	27	75	5,714		
V. Paper, printing, and stationery .	11	12	21	990	...	159	21	1,149	25	1,271	...	238	25	1,509		
VI. Chemicals	27	27	31	1,102	2	22	33	1,124	31	1,439	...	35	31	1,474		

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VII. Wood: sawmillers and carpenters	15	...	15	25	1,448	...	24	25	1,472	16	1,447	...	32	16	1,479
VIII. Miscellaneous articles.	33	...	33	26	958	2	122	28	1,080	15	936	1	147	16	1,083
IX. Glass	2	...	2	12	900	...	10	2	510	12	822	1	22	13	844
X. Food	11	...	11	12	508	2	82	14	590	21	656	1	159	22	815
XI. Metal extraction	29	...	29	38	556	...	...	...	38	556	33	752	2	33	754
XII. Gas	13	...	13	15	544	...	...	15	544	16	759	...	...	16	759
XIII. Drink	17	...	17	20	442	...	57	20	499	13	594	1	83	14	677
XIV. Print, bleach, and dye works	23	...	23	13	501	...	34	13	535	21	566	...	33	21	599
XV. Metal galvanising and finishing	...	...	...	...	329	...	44	1	373	2	449	...	73	2	522
XVI. Clay and stone working	10	...	10	10	228	...	23	10	251	27	412	...	27	27	433
XVII. Clothing	1	2	3	2	336	...	69	2	405	3	359	...	92	3	451
XVIII. Other Non-Textiles	5	3	8	12	755	2	112	14	867	13	1,028	1	97	14	1,125
(Divisions XII, XV, XVIII, XX., and XXII. to XXVI., in Table IV., Chap. I.)															
Non-Textile Total	428	7	435	462	30,120	8	977	470	31,097	511	42,930	5	1275	516	44,205
1895 ACT.															
Employment at—															
I. Docks, wharves, and quays	63	...	63	88	2,853	...	6	88	2,859	89	4,067	...	3	89	4,070
II. Warehouses	7	1	8	12	950	...	6	12	956	16	2,595	...	2	16	2,597
III. Building construction and repair	21	...	21	40	257	...	...	40	257	42	452	...	...	42	452
IV. Laundries with mechanical power	...	...	...	1	65	1	136	2	201	...	47	...	168	...	215
V. Buildings in use	...	...	...	...	19	...	...	...	19	3	156	...	8	3	164
1895 Act. Total	91	1	92	141	4,144	1	148	142	4,292	150	7,227	...	181	150	7,408
Employments															
Grand Total.	585	11	596	641	36,808	14	2931	655	39,739	715	53,222	10	3476	725	56,698

and for the Dock and other employments from which casualties are reportable.

Fatal Accident.—The Textile contribution to factory mortality in 1896, 1897, and 1898 was 69, 43, and 59 respectively, of which three only in the first year and five in each of the latter years occurred to females. The non-textiles furnished in Groups I. to IV. — Metal manufacture and conversion—232, 234, and 263 deaths, including only one fatality—in 1896—to a female. In Groups V. to VIII.—the Paper, Chemical, Wood, and Miscellaneous Article Industries—the yearly deaths from accident were 87, 107, and 89 respectively, four of these in 1897 and one in 1896 and 1898 occurring to females; the figures for the remaining ten non-textile Groups IX. to XVIII. being 116, 129, and 165, and including five deaths of females in 1896 and four in 1897 and 1898. In the Dock and other employments there was an increase of eight fatalities in 1898 over 1897, three of these however occurred at Buildings in use, from which no accidental deaths had been previously reported and no mortality was notified from laundries, or to females.

The net increase in fatal accident in factories and the above employments during 1898 was 70. Of this Textiles accounted for 16 but their fatalities were still 10 less than those for 1896. In non-textiles, Groups I. to IV. —employing 28·7 per cent. of the total factory workers —contributed 29 more deaths than in 1897, of which No. I., Engineering, accounted for 25. Groups V. to VIII., with 14·8 per cent. of the workers, had 18 fewer deaths, while Groups IX. to XVIII. with only 27·7 per cent. of the operatives had no less than 41 additional deaths in 1898—an increase of 45 per cent. The increase from the dangerous metal trades would probably have been less had the figures for 1897, which related to the period

covered by the great engineering trade dispute, been those of a normal year, but the advance in fatalities in Groups IX. to XVIII. is quite exceptional, is shared by all the divisions except Metal Extraction, Drink, and the minor non-textiles, and is most marked in the Glass, Food, Bleach, and Clay and Stone trades which have not hitherto bulked largely in the serious accident returns.

Non-Fatal Accident.—The increase in reported non-fatal factory accident during the three years since the lower time and causation standard came into operation has been very general and considerable.

The data for industrial groups during 1896 are not extant, but a comparison of the figures in Table X. relating to 1897 and 1898 shows an increase of 16,959—42·6 per cent.—in the non-fatal injuries of all kinds reported from factories in the latter year. Of that number 3173—20·7 per cent.—represents the increase in the usually more serious accidents of this class reportable to certifying Surgeons as well as to Inspectors, and of this increase 70·4 per cent. was sustained by male adults, 19·5 per cent. by male young persons, 7·7 per cent. by women, and 2·7 per cent. by female young persons. Serious non-fatal injury to male children was practically stationary and in the case of female children was less by 21·7 per cent.

A balance of 13,786 from the reported non-fatal accident increase in 1898 remains, which is composed to some extent of trivial injuries necessitating little more than the prescribed brief absence from work and also of more serious casualties which are largely unpreventable by any of the statutory regulations.

The increased contribution from the new Dock, Warehouse, and other employments was, as might be expected, considerable in the third year of their inclusion, being 47

per cent. for casualties reportable to certifying Surgeons and as much as 75·2 for injuries reportable to Inspectors only.

Fatal accident in the latter employments has probably been generally reported, as only eight of an increase is recorded, but the above non-fatal injuries may possibly be even greater with fuller reporting and may fluctuate considerably owing to the nature of the occupations.

The unusual mortality increase of 44 from the non-textile trades, Glass, Food, Bleach, Clay and Stone—which employ only 11·3 per cent. of the factory operatives—is equal to 62·8 per cent. of the total fatality advance, and is not likely to be maintained.

In conclusion it should be noted that, so long as the present low time standard and somewhat arbitrary classification is maintained by the Statute, Accident Returns can only be appreciated after discriminating analysis on the lines which have been indicated.

CHAPTER III.

LEGISLATION ON ACCIDENT AND SAFETY.

ACCIDENT.

FACTORY legislation has dealt with accident in Factories and Workshops in three directions, namely, *Notification*, *Registration*, and *Investigation*.

Notification of Accident.—The term “Accident” is not defined by any statute, but in the Factory Acts and relative legislation it has the popular significance of any sudden occurrence, apart from the act of God, illness, or personal violence, by which bodily injury is sustained by any person within the precincts of a factory or workshop, including a workshop employing men only, and the laundries, docks, wharves, quays, warehouses and buildings added for this purpose by the Act of 1895.

Notification of any such injury must be made forthwith to the Inspector of Factories and Workshops for the district when death ensues, or when the person is prevented from performing five hours’ ordinary work on any one of the three working days next after the occurrence.

Factory Act,
1895, Sec. 18,
22 (1), (4),
23 (3).
Notification.

In addition, where notifiable injuries have resulted fatally or have arisen from certain specified causes, namely—machinery in motion by mechanical power, a vat, pan, or other structure filled with hot liquid, or molten metal, or other substance, or an explosion, or

escape of gas, metal, or steam which does not require reporting otherwise under Section 63 of the Explosives Act of 1875, a similar Notice must be sent forthwith to the Certifying Surgeon of the district.

The following is a notice in the form prescribed by the Secretary of State of a factory accident at machinery moved by mechanical power and therefore reportable *both* to Inspector and Certifying Surgeon.

TABLE XI.

FACTORY AND WORKSHOP ACTS, 1878 TO 1895. NOTICE OF ACCIDENT.	
1. { Name of the Factory or Workshop Name and address of Occupier (Firm or Company) . . .	Harbour Saw Mills. Peter Anderson, 16 High Street, Wick, Caithness.
2. Nature of Industry . . .	Timber Sawing.
3. { Date and hour of accident . . . Time injured person began work on day of accident . . .	May 5, 1899—5·20 P.M. 7 A.M.
4. Name of injured person . . .	Hector Macdonald.
5. Age of injured person . . .	28.
6. Sex of injured person . . .	Male.
7. Occupation of injured person . . .	Labourer.
8. By what part of machinery in motion or in what other way the accident was caused; and how the injured person was employed at the time of the accident . . .	{ At a circular saw in motion by steam power. He was employed saw- ing a board when his left hand slipped off the wood and came in con- tact with the saw teeth.
9. Residence of injured person . . .	20 Bridge Street, Wick.
10. Place to which injured person has been removed . . .	His father's residence, 12 High Street, Wick.
Signature of occupier, manager, or agent .	PETER ANDERSON.
Date	May 5, 1899.

For the special purpose of obtaining records of certain injuries to health—as distinguished from accidents proper—every case of lead, phosphorous, or arsenical poisoning, or anthrax occurring in a factory or workshop is a reportable accident within the meaning of the Acts and notice of the same in the above form must be sent forthwith to the Inspector and to the Certifying Surgeon for the district. The Secretary of State may by statutory order apply this provision to any other disease occurring in a factory or workshop and by Order dated 27th March, 1899, cases of mercurial poisoning so arising are likewise reportable. Also where any unreported case of the five diseases named, contracted in any factory or workshop, comes under the notice of a medical practitioner attending or called in to visit in connection therewith, he must, under a penalty not exceeding forty shillings for failure to report, notify the case in writing to the Chief Inspector of Factories at the Home Office, London, and is entitled for every such notice to receive from the Secretary of State a fee of two shillings and sixpence.

Factory Acts,
1878, Sect. 65,
1895, Sect. 29.
Notification of
certain
diseases.

Registration of Accident.—Every occupier of a factory or workshop must keep a register of accidents and must enter therein every accident occurring in the factory or workshop of which notice is required by the Factory Acts within one week after the occurrence, and this register must be at all times open to inspection by the Inspector and by the Certifying Surgeon for the district.

Factory Act,
1895, Sect. 20.
Registration.

The particulars of the sawmill accident above which would require to be registered are given on page 38.

In this way a chronological record of all the notifiable casualties in either class of premises is obtained which is of much value to occupiers and managers of works who interest themselves in the prevention of accident and also to the Inspector and Surgeon at their visits.

TABLE XII.

REGISTER OF ACCIDENTS.	
1. Date of accident	May 5, 1899.
2. Name of injured person	Hector Macdonald.
3. Age of injured person	28.
4. Sex of injured person	Male.
5. Occupation of injured person	Labourer.
6. By what part of what machinery in motion or in what other way caused, and how the injured person was employed at the time of the accident	{ At circular saw in motion by steam power. He was employed sawing a board when his left hand slipped off the wood and came in contact with the saw teeth.
7. Degree of injury (<i>i.e.</i> , slight or severe)	Severe.
8. Nature of injury, according to classification below*	{ (e) Lost part of left hand, point of thumb, and forefinger at first joint being cut off.
<p>* The nature of the injury should be clearly described under one or other of the heads in the following classification :—</p> <p>(a) Causing death ; (b) loss of right hand or arm ; (c) loss of left hand or arm ; (d) loss of part of right hand ; (e) loss of part of left hand ; (f) loss of any part of leg or foot ; (g) fracture of limbs or bones of trunk ; (h) fracture of hand or foot ; (i) loss of sight of one or both eyes ; (j) injuries to head and face ; (k) burns and scalds ; (l) lacerations, contusions, and other injuries not enumerated above.</p>	

Failure to comply with the registration provision is punishable by a fine not exceeding Ten pounds.

Factory Act,
1878, Sect. 68.
1895, Sect. 22
(1), (4).
1895, Sect. 23
(1), (3).

By an
Inspector.

Investigation of Accident.—An Inspector under the Acts has all the powers necessary for entering a factory or workshop, or laundry, or other premises deemed to be a “factory” under the Act of 1895 and examining documents, registers, or persons in any inquiries which he may consider it necessary to make into an accident or other statutory matter, and occupiers must afford *all facilities for such purposes*.

Throughout the United Kingdom there are two thousand

Surgeons each authorised to act under the Factory Acts for a definite and limited area. It is the duty of every Certifying Surgeon so appointed, amongst other matters, to make early inquiry into every accident notified to him from a factory or workshop or other premises under the Act, and transmit his report to the Inspector within twenty-four hours of the investigation. The form of this report is the same as that prescribed for the registration of accident.

Factory Act,
1878, Sect. 32.
By a Certifying
Surgeon.

The powers of an Inspector are, for this purpose only, conveyed to a Certifying Surgeon, and the latter is additionally authorised to enter in the course of his investigation any room or place to which the person killed or injured has been removed. He is also entitled to be paid by the Secretary of State for the investigation such fee not exceeding ten nor less than three shillings, according to the scale fixed by the latter.

When it appears expedient the Secretary of State may direct the holding of a formal investigation into the circumstances and causes of an accident occurring in a factory or workshop including a workshop employing men only and the premises added by the Act of 1895, and the provisions of Sections 45 and 46 of the Coal Mines Regulation Act, 1887, are prescribed for conducting such special inquiry.

Factory Act,
1895, Sects. 21,
22 (1).
1895, Sect. 23
(1), (2).
By order of the
Secretary of
State.

Provision is made in the case of an inquest by a Coroner and jury into the death of any person from accident in a factory or workshop for timely notice from the Coroner to the Inspector of the holding of such, for adjournment under certain circumstances in the absence of a representative of the Home Office, and for the representation and power to cross-examine by counsel or personally, at an inquest, of the deceased's relatives, fellow-workmen, and employer, as well as the Inspector.

Factory Acts,
1891, Sect. 22.
1895, Sect. 19.
By a Coroner
and jury.

Fatal Accidents Inquiry (Scotland) Act, 1895. Sects. 4 and 5.

By a Sheriff and jury.

In Scotland, where coroner's inquests are not held but industrial fatalities are inquired into by a Sheriff and jury, provision is made for timely notification from the Sheriff Clerk of a County to an Inspector of inquiry into a fatality occurring in a factory or workshop, and for evidence from or cross-examination by such Inspector, the deceased's relatives, fellow-workmen, employer, or other parties having an interest in the matter.

SAFETY.

Factory Act, 1878, Sect. 96.
Employees.

Definitions.—In connection with the subject of Safety the Factory Acts recognise four classes of persons amongst industrial employees, namely, a "child," a "young person," a "woman," and "men". The first is a person under the age of fourteen years, the second a person of the age of fourteen years and under the age of eighteen years, the third a woman of eighteen years and upwards, while the remainder, though not specifically defined, forms the fourth class and obviously consists of all males of eighteen years of age and upwards.

Factory Act, 1878, Sect. 94.
Employment.

A "child," "young person," or "woman" is employed within the meaning of the Acts when engaged, whether for wages or not, at any kind of work whatsoever connected with a manufacturing process, a handicraft, or the making of any article, or in cleaning any part of the factory or workshop, or in cleaning or oiling any part of the machinery therein, and a person *not* employed by the occupier of a factory but working therein for the time being has the same protection from accident.

Factory Act, 1895, Sect. 7 (2)
Or working.

Factory Acts, 1878, Sect. 5.
1891, Sect. 6.
1895, Sect. 7.

Safe-guarding.

Prevention of Accident.—Protection of life and limb has for more than half a century been a feature of the Factory Acts, and has in recent years become more prominent, the clauses of the statutes dealing with this

matter having been several times amended and extended to strengthen the hands of Her Majesty's Inspectors and secure greater care in the conduct of industry. The ordinary safety provisions recognise degrees of danger in the various classes of machinery in any factory under the 1878 Act, and in any laundry using mechanical power.

In the first place the absolute safe-guarding and maintenance of secure fencing at every part of any form of prime mover is required. In this category are included all steam, gas, oil, and other engines, electric motors, windmills, water-wheels and turbines. Every fly-wheel directly connected with mechanical power, whether in the engine-house or not, and every wheel race and hoist also requires to be securely fenced.

Second in order comes the machinery involved in the transmission of power from the prime mover to the various machines in a factory.

Every part of the shafts, wheels, drums, or pulleys Factory Act, 1878, Sects. 5 and 96. used for such a purpose constitutes "Mill gearing" with- in the meaning of the Acts, and must *either* be securely fenced or be in such position or of such construction as to be equally safe to every person employed or working in the factory as it would be if it were securely fenced. "Mill gearing."

In practice if no portion of the mill gearing parts just mentioned is less than seven feet from the floor and no nearer approach is made to them in motion *under any circumstances* by any person in the factory they are considered to be as safe as if they were securely fenced. It must be borne in mind however, that, in many factory industries, the stoppage of the whole transmission machinery for the purpose of a near approach to the mill gearing when a bearing gets hot, a lubricator empties, or a belt or wheel needs adjustment, is never entertained, and in such cases suitable safe-guarding *must* be provided

under the statute even at lofty mill gearing as a protection for the person or persons whose duty it may be to approach the latter in motion, however infrequently.

It will be noted that "mill gearing" does not embrace any flexible transmitters of power such as the belting, ropes, or chains, which so often at the present day are links between the parts which are included in that term. This is due to the fact that the "mill gearing" definition still extant is fifty-five years old, and in millwright practice, at that distant date, shafts and toothed gearing invariably formed the major portion of the transmission machinery, and driving straps or bands did not occur in the gearing until actual connection with a machine required to be made, in which case the last drum or pulley on the main driving shaft terminated the "mill gearing". The omission for so long a period to bring the definition of the latter into conformity with modern engineering methods, in which powerful straps and bands are often much nearer the person than the shafts, drums, or wheels, calls for the attention of the legislature.

Meanwhile the regulations governing the third class of machinery provide to some extent for dealing with the matter.

Factory Act,
1891, Sects. 37
and 6 (2).

Machinery and
dangerous
machinery.

Factory Act,
1878, Sect. 6.

Dangerous
machinery.

"Machinery" is now declared to include any driving strap or band, and all "dangerous parts of the machinery" require to be securely fenced under the same conditions as to position and construction as those already discussed in connection with "mill gearing".

Dangerous machinery was formerly required to be fenced after notice in writing from an inspector, but owing to its combination with elaborate and tedious arbitration proceedings in the case of every disputed detail the provision was of little practical value and was superseded by the above. The occupier of a factory, in

addition to the two classes of machinery first mentioned, has now to fence absolutely his dangerous machinery of every description, or provide it of equally safe construction, and disputed cases of neglect or refusal to safeguard a dangerous part are now decided in detail solely by a court of summary jurisdiction on the evidence adduced. The prefixing by the 1891 Act, Section 6 (2), of the words "all dangerous parts of the machinery and" to Section 5 (3) of the Act of 1878 has enormously increased the scope of the safe-guarding provisions, which thereby practically cover all factory operations by machinery, other than prime movers, mill gearing, and hoists which, as we have seen, are *primâ facie* dangerous, where danger may be presumed and guarded against, and the procedure for interpreting the words in cases of difference of opinion is both rapid and satisfactory.

In one case only of "dangerous parts of the machinery" does the statute condescend upon details, namely, in non-textile tenement factories where grinding is carried on. These are largely found in the Sheffield cutlery trade where numerous small occupiers using a common prime mover are congregated in the same buildings and rooms constituting a factory. In such cases specific attention is prescribed to horsing chain and hook attachments at the grinder's sitting place, prime mover control, the fencing of belts, pulleys and grindstones, the drainage of floors, and the running of stones clear of fireplaces, doors, or other entrances, and of each other, owing to the frequency with which they develop flaws and fly to pieces with great violence.

All the fencing already specified must be constantly maintained in an efficient state while the parts required to be fenced are in motion or use, except where the parts are under repair, or under examination in connection

Factory Act,
1895, Sect. 25
and schedule.

Tenement
grinding
factories.

Factory Act,
1895, Sect. 7(3).

Maintenance
of fencing.

with repair, or are necessarily exposed for the purpose of cleaning or lubricating, or for altering the gearing or arrangement of the parts of the machine.

Factory Acts,
1878, Sects. 9
and 81.
1895, Sect. 25
(4).

Penalties.

Neglect to observe any of the foregoing safe-guarding requirements is deemed to be failure to keep a factory in conformity with the principal Act, and is punishable by a fine not exceeding Ten pounds, and, in addition to, or instead of inflicting such fine, the court may order certain steps to be taken under time limit, which may be extended, in order to secure conformity, and failure to comply after the expiration of the time ultimately fixed is punishable by a fine not exceeding One pound for every day that such non-compliance continues.

Factory Act,
1878, Sect. 82.

Penalty in case
of death or
bodily injury.

The penalty for neglecting in a factory or in a laundry using mechanical power to provide or to maintain fencing at any part of the machinery required by Statute to be securely fenced may be increased to a sum not exceeding One hundred pounds where any person is killed or suffers any bodily injury in consequence, and the whole or any part of such penalty as may be recovered may be applied for the benefit of the injured person, or his family, or otherwise as the Secretary of State determines.

Factory Acts,
1891, Sects. 8
to 12.
1895, Sects. 23
and 28 (2).

Special rules
for dangerous
trades.

An entirely new class of safety provisions was introduced into factory legislation in 1891 when power was given to the Secretary of State to certify as "dangerous" any machinery, process, or description of manual labour in a factory or workshop, including, after 1895, men's workshops and any dock, wharf, quay, warehouse, or building operations by mechanical power, which in his opinion appeared to be dangerous amongst other things to life or limb either generally or in the case of women, children, or any other class of persons. The Chief Inspector of Factories was at the same time empowered to propose to occupiers the adopting of such Special

Rules or measures as appeared to him to meet the necessities of such cases, and provision was made for dealing with objections by arbitration according to the Schedule of the Act of 1891, for the future amendment of Special Rules when established and publication of them by exhibition and distribution of printed copies. Twenty-three industries have already been certified as dangerous under these powers and Special Rules have been established, but, in so far as such requirements apply to the danger to life or limb from accident with which this work is concerned, as distinguished from danger or injury to health, they are confined to the fencing of vats and pans and ventilation of dangerous gases in the chemical and explosive industries, and the provision of masks, screens and gauntlets in the bottling of aerated water where the bursting of the charged bottles is frequent and dangerous.

For the purposes of Special Rules or requirements the expression "process" is to include the use of any locomotive. Factory Act, 1891, Sect. 37.

The observance of the duties assigned to occupiers and persons employed respectively under any Special Rules or requirements is provided for by penalties which may be inflicted on either or both parties as the circumstances may require, and a Factory or Workshop or other premises in which any such contravention takes place is deemed not to be kept in conformity with the principal Act. Factory Act, 1895, Sect. 9.

Penal compensation may also be claimed for death or injury to health or limb caused by such contraventions. Factory Acts, 1878, Sect. 82. 1895, Sect. 13.

Limitations are placed by the Acts upon the employment and position about machinery in motion of certain classes of persons who, experience has shown, cannot be relied upon to so work without accident. A child is not Factory Acts, 1878, Sect. 9. 1895, Sects. 8 and 9. Safe working.

allowed to clean any part of a machine, whether fixed or in motion, while the moving part is operated by mechanical power. A young person is similarly prohibited from being employed in cleaning any "dangerous parts of the machinery," and a young person or woman may not clean mill-gearing in motion by mechanical power. Children, young persons and women may not be allowed to work between the fixed and traversing parts of any self-acting machine — a spinning mule, for instance — while the machine is in motion by mechanical power, and *no* person employed in a factory may be in the space between the latter parts unless the machine is stopped with the traversing portion on the outward run. In the space referred to the area in front of a self-acting machine is not included.

Factory Act,
1895, Sect. 9.

Safe construction: position of self-acting machine.

In any factory erected after the first day of January, 1896, the traversing portion of any self-acting machine must be so arranged that it shall not run out within a distance of eighteen inches from any fixed structure, not being part of the machine, if the space over which it runs is at any time liable to be used by any one as a passage.

Factory Act,
1878, Sect. 83.

Penalty.

Failure to comply with any of the above safe working or safe construction regulations is deemed to be employment contrary to the provisions of the principal Act and a penalty not exceeding Three pounds may be imposed for each person so employed.

Factory Act,
1895, Sects. 4
and 23 (4).

Safe construction: dangerous machine.

Temporary or permanent interdict is also provided for on the application *ex parte* of an Inspector to a court of summary jurisdiction in the case of any machine in a factory or workshop or at a dock, wharf, quay, warehouse, or in building operations by mechanical power, the use of which is proved to be dangerous to life or limb.

Similar powers are also conveyed to a court of summary jurisdiction on the application of an Inspector, on

being satisfied that any place used as a factory or work-
shop, or part of such, is in such a condition that employ-
ment therein is dangerous, amongst other things, to life
and limb. Any contravention of the above orders of
court is punishable by a fine not exceeding forty shillings
a day during such contravention.

Factory Act,
1895, Sect. 2.

Safe construc-
tion :
dangerous
premises ;
structural
defects.

The occupier of every factory constructed since 1st
January, 1892, and of every workshop erected since 1st
January, 1896, and in which more than forty persons are
employed, must be furnished with a certificate from the
Sanitary Authority of the district that the factory or
workshop is provided on the storeys above the ground
floor with such means of escape in case of fire for the
persons employed therein as can be reasonably required
under the circumstances of each case. It is the duty of
the Sanitary Authority to make the necessary examina-
tion, and if satisfied to grant the prescribed certificate,
and a factory not so furnished is deemed not to be kept
in conformity with the principal Act. For the same
purposes the Sanitary Authority is also empowered to
deal with all factories and workshops of the above
dimensions erected before 1st January, 1892, and 1st
January, 1896, respectively, and disputes are to be settled
by arbitration. On satisfying a court of summary juris-
diction an Inspector may obtain an order for the pro-
vision of movable fire-escapes in connection with a
dangerous factory or workshop. Doors must not be
locked or fastened in such a manner that they cannot
be easily and immediately opened from the inside by
employees while on the premises for employment or
meals, and in every factory or workshop the construction
of which was commenced after 1st January, 1896, the
doors of each room in which more persons than ten are
employed must, except in the case of sliding doors, be

Factory Acts,
1891, Sect. 7.
1895, Sects. 10
and 11.

Safe construc-
tion :
dangerous
premises ;
fire-escape.

made to open outward. Failure to implement an order of court with regard to provision of fire-escapes is punishable by a fine not exceeding forty shillings a day during such contravention, and a factory or workshop in which doors are fastened or constructed contrary to the above provisions is deemed not to be kept in conformity with the principal Act.

The provisions just enumerated for the prevention of accident and embracing the safe-guarding of machinery and plant, the regulation of labour about them, and the structural safety of the premises constituting factories and workshops are the result of many years' consideration and practical experience by Her Majesty's Inspectors of the risks to be encountered in manufacturing industries. The various methods of giving practical effect to the body of legislation here summarised are discussed and illustrated in Part II. of this work.

CHAPTER IV.

EMPLOYERS' LIABILITY FOR ACCIDENT.

FAILING agreement with his employer, a workman's legal remedies for injury sustained by accident within, amongst other places, the close or curtilage of a "Factory" under the 1878 Act, or premises deemed to be a "Factory" under the 1895 Act, are of two kinds, namely, Actions at Law and Statutory Arbitration.

Actions at Law.—Amongst such possible sources of compensation for accident is any prosecution which the Crown may undertake against the occupier of a factory for breach of statutory duty whereby a workman has been injured or killed, and in which the penalty recovered may, under certain circumstances, reach the injured person or family without prejudice to any civil right of action they may possess.

The law of the United Kingdom under which a workman may on his own behalf raise an action for damages for injury sustained by accident in course of his employment is to be found in two departments, namely, the *Common Law* or unwritten legal right derived from usage, custom and judicial precedent, and the *Statute Law* as expressed by Acts of Parliament.

The Common Law of both Scotland and England recognises the right of any person injured by the misconduct or negligence of another to be compensated by the latter under certain circumstances for the results of such injury, and the claim may also condescend upon any related

breach of statutory duty under the Factory or other Acts which, of themselves, are silent as to civil remedies.

The Statute Law provides restricted and alternative remedy in an action at law under the Employers' Liability Act of 1880 for workmen killed or injured under certain conditions in the course of their employment.

The main features of these several classes of action at law are described in this chapter.

Statutory Arbitration. — This is an additional and definite remedy without recourse to action at law in the case of workmen killed or injured in course of employment about certain places, including all Factories, which has been provided by the Statute Law in the Workmen's Compensation Act of 1897. In the next chapter the scope of this important measure, which has been in operation for one year, is described, and factory accidents and accident rates are discussed in relation to it.

Penal Compensation.—The penalty not exceeding Ten pounds imposed upon the occupier of a factory under Section 81 of the Factory Act, 1878, for having neglected to fence the machinery, vats, pans, or other structures prescribed by the Acts, or to maintain such fencing may, as has been seen in the previous chapter, be increased under Section 82 of the principal Act to a maximum of One hundred pounds if any person is killed or suffers any bodily injury in consequence of such neglect. The latter section as amended by Sections 13, 22, and 23 of the Act of 1895, also, in the case of both a factory and a workshop and of laundries, docks, wharves, quays, warehouses, and premises in which mechanical power is used for building purposes, extends the penalty to cases of death, bodily injury, or injury to health caused by an occupier's neglect to observe any other provisions of the Factory Acts or any Special Rule or requirement made in pur-

suance of the Act of 1891 ; provided that in case of injury to health the occupier shall not be liable unless the injury was directly caused by his neglect.

The whole or any part of the penalty so recovered may be applied for the benefit of the injured person or his family, or otherwise as a Secretary of State determines. Such penal compensation does not necessarily bear any relation to the injury sustained, and is usually based upon the nature of the contravention. If so awarded in whole or part it does not take away the right to raise an action for civil compensation either under the Statute or at Common Law, but from the award in successful proceedings under the Employers' Liability Act of 1880, or the Workmen's Compensation Act of 1897, any sum received as above must be deducted. In the case however of the Employers' Liability Act, 1880, no injured person or representatives can benefit from penal compensation received in the form of a fine under the Factory Acts *after* the termination of civil proceedings. Apart from penal compensation which may or may not reach the workman or his representatives the other claims at law for damages described in this chapter are alternative.

Common Law Compensation founded upon breach of Statutory Duty.—Until recently it was not quite clear whether a civil claim at Common Law in England and Wales for compensation for injuries, based solely upon this head, could be successfully made in the case of accident under the Factory Acts, which do not deal with a workman's remedies other than that just discussed. Before the principal Act was passed the right appeared to be acknowledged, but in later cases it was held that, unless the statute founded upon showed an intention to create such a right, the latter could not be held to exist.

The matter however appears to be now settled, so far at least as the Factory Acts are concerned, in favour of the workman by the decision in *Groves v. Lord Wimborne* of the Court of Appeal given on 28th June, 1898.

The judge at Assizes had held that no civil action for compensation could lie under Section 5 of the Factory Act of 1878, for injury at machinery admittedly not fenced as required by the statute, because Section 82 of the same Act provided a penalty for any breach of Section 5 which caused injury or death. He directed judgment to be given for the defendant, and also found that no negligence on the part of the latter had been established. The case was appealed, and the Court of Appeal allowed the appeal and entered judgment for the plaintiff.

In giving judgment the Court of Appeal said, that the Factory and Workshop Act, 1878, was passed by the Legislature in favour of the workmen, in order to compel the master to do certain things for their protection. Section 5 imposed an unqualified obligation to fence certain machinery and to maintain the fencing. It was conceded that the machinery came within the Section. It could not be doubted that, if Section 5 stood alone, a cause of action would have accrued to the plaintiff. Unless it could be found that upon the whole purview of the Act it was intended that the only remedy should be the imposition of a fine upon the master for the breach of his statutory duty, it was clear that the Act gave a right of action to the injured person upon proof of the breach of the statutory duty and the injury caused thereby. If a penalty were inflicted on an employer for a breach of duty, the fine should be proportionate to the character of the offence, and not proportionate to the injury inflicted on the workman. However, whatever penalty was inflicted, it would not necessarily go into

the pocket of the injured workman, because by Section 82 the Home Secretary might, in his discretion, but was not bound to, apply the whole or any part thereof for the benefit of the injured person. Further, by Section 87 the occupier might be exempt from a penalty, and a workman, who was the real offender, might be fined instead, when he might not have a penny to pay the fine with, and yet the argument was that in such a case the injured workman must look to the fine as his sole possible compensation. The court was of opinion that the plaintiff had a cause of action upon the statute. On the point of common employment the court held that the plaintiff had only to prove a breach of the statutory duty and injury to himself therefrom, and that it was no answer to say that the injury was caused by the negligence of a fellow-servant. The defendant could not delegate his statutory duty to another.

Common Law Compensation under Lord Campbell's Act (The Fatal Accidents Act, 1846).—This Act does not apply to Scotland where the Common Law already provided a remedy in case of death from accident. Throughout the rest of the Kingdom, however, the representatives of a person killed by accident before the passing of this Act could not claim the damages for injury which the deceased would have been entitled to had death not ensued. Lord Campbell's Act makes possible within twelve months of death the maintenance of an action at law for damages, without specified limit as to amount, for the benefit of the relatives of the deceased named in the Act, against any person who by his wrongful action, neglect, or default may have caused the death of another person.

Common Law Actions.—At Common Law an action for damages, to the amount of which no limit is attached, by an injured person or certain relatives will lie if injury

is caused from defective machinery, plant, or material due to the personal fault of the employer. The employer is also liable for personal fault in selecting an incompetent servant through whose incompetency a workman suffers injury. A workman however cannot claim under this head for injury arising out of the ordinary risks of his employment, or caused by the negligence of a fellow-workman except where the latter is the servant of another master in which case that employer is liable.

The workman's knowledge of defects may preclude recovery of damages at Common Law if he continues working, unless on reporting the danger he is ordered to continue or unless it is clearly established in evidence that the workman had not voluntarily agreed to relieve his employer from the consequences of the danger which caused the accident.

Statute Law Compensation under the Employers' Liability Act, 1880.—The provision made under the Common Law for solatium in case of personal injury incurred by workmen has always been regarded as unsatisfactory, particularly with regard to the doctrine of common employment which compels the injured person to suffer all the consequences of his fellow-workmen's carelessness or default.

An attempt was therefore made in 1880, independently of the existing law, to alter this state of matters by statute in favour of the workman, but, at the same time, the necessity for carefulness on the part of the latter was emphasised and the liability of the employer was limited in amount and in the number of employments to which the new provision extended.

This Act applies amongst other industrial employments to workmen engaged in factories and workshops but only to such of these as are the actual servants of the occupiers of such places.

The amount of compensation recoverable is limited to a maximum equivalent to three years' wages of a person at the time in the same grade of employment in the district, and may be awarded on proof of the negligence of the employer, his foreman or other workman to whose orders the injured person conformed as part of his duty.

This negligence and the resulting accident may have arisen in connection with defect in the machinery, plant, or premises, or in the method of using such, but the fact that a machine or other part is dangerous must be connected with negligence on the part of the employer or of some one entrusted by him with securing its safe condition.

Where the employer or superior of a workman did not know of the defect or negligence alleged to have caused injury, and the latter knew but did not give notice of such within a reasonable time, or where the defect did not remain undiscovered from any negligence on the part of the employer or superior, the workman is not entitled to recover damages. Notice of injury must be given for the purpose of this Act within six weeks of the accident, and the action commenced within six months of injury, or, in case of death, within twelve months from the time of death. In case of death want of timeous notice may be excused if in the opinion of the judge there has been reasonable cause for delay.

Any penal compensation awarded to an injured person must be deducted from any compensation obtained under this Act. Masters may agree with servants as a condition of employment that this Act shall not be applicable to their particular service and the acceptance of insurance benefits after accident by a workman who professed no knowledge of such a contract has been held to preclude the recovery of any sum under this Act.

CHAPTER V.

THE WORKMEN'S COMPENSATION ACT, 1897.

Origin of the Act.—In the sixteen years during which the Employers' Liability Act of 1880 represented the latest contribution of the legislature to the difficult subject of remedy for injuries from industrial accident, much reason for dissatisfaction with the measure was found. In the first place the great expansion of engineering and non-textile factory enterprise in general served to increase the number of casualties unremediable under the Act or at Common Law, and yet not due to fault on the part of the injured person. In the second place the expenses of an action at law, which was the only method of settling a disputed claim, were a grievous tax upon both parties to the suit. In successful proceedings the many charges incurred which could not be included in the legal costs greatly diminished the sum of money which was in the end received by the workman or his representatives, while on the other hand a decision in favour of the employer was also costly, for the expenses awarded to the latter were practically unrecoverable. A speedier and juster solution of the problem was desired on all hands, and various proposals were made and presented for the consideration of Parliament, but of these only the Act of 1897 received the approval of the legislature. This measure is a professedly tentative one upon entirely new lines. It substitutes statutory arbitration for action at law and conditionally provides not only for definite

compensation to dependants in case of death but also for specific aliment during permanent or temporary incapacity for work owing to accident.

As its scope, results, and possible extension are more intimately related to the subject of accident and safety in factories than those of the preceding and unrepealed Statutes, it is here described and discussed at fuller length in its practical aspects.

Provisions of the Act.—The object of the Workmen's Compensation Act, 1897, which came into force on 1st July, 1898, is to give workmen, or in cases of death their dependants, definite compensation for all personal injuries by accident arising out of or in course of specified employments. The principle, a wholly new one, on which this provision is made, is, “that where a person, on his own responsibility and for his own profit, sets in motion agencies which create risks for others, he ought to be civilly responsible for the consequences of what he does”.

The cause of the accident is practically immaterial; it is the fact of the injury which entitles to compensation. To this increased liability there are, however, certain conditions attached, namely:—

- (1) No compensation is recoverable unless the disablement prevents the workman for a period of at least two weeks from earning full wages at the work at which he was employed.
- (2) Nothing in the Act affects the existing civil liability of the employer, but workmen, or in case of death certain of their dependants or relatives may, at their option, either claim compensation under this Act, or take such proceedings as are competent under the Statutes already described, and which were open to them before the commencement of this Act.

- (3) No compensation claimed under the Act is allowable if it is proved that the injury to a workman is attributable to his own serious and wilful misconduct.

To maintain a claim under the Act notice of injury from accident must be given as soon as practicable, and before a workman has voluntarily left the employment in which it occurred. The claim must be made within six months of the accident, and, in case of death, within six months of that event. Where there is a want or defect in the prescribed notice the claim may stand if the defence of the employer remains unprejudiced thereby, or if the defect was occasioned by mistake or other reasonable cause. Failing agreement between employer and claimant, arbitration in accordance with the second schedule to the Act is provided for either privately before a representative Committee or at the expense of the Crown, and from such award as may be made in accordance with the first schedule to the Act the penal compensation, if any, which may have reached the workman in connection with a Factory Act prosecution, must be deducted. Provision is made for obtaining stated cases, on questions of *law* arising out of arbitration proceedings, for the opinion of the Superior Courts. Contracting out is also permitted in the case of private schemes of compensation in which the employees concur and which the Registrar of Friendly Societies after inquiry has certified to be on the whole not less favourable to the workmen than the compensation provided for by this Act.

The scale and conditions of the compensation provided under the Act are set forth in the first schedule to the same, and are briefly summarised here. In case of death from injury a payment to the workman's dependants of a sum equal to his earnings under the employer concerned

during the three years immediately preceding the injury and proportionate to the weekly earnings where less than three years' employment has taken place, provided that the sum paid shall not exceed Three hundred pounds nor be less than One hundred and fifty pounds. Provision also is made for similar payments either by agreement or after arbitration to those only partly dependent upon the deceased workman, and for medical and burial expenses, limited to Ten pounds, where no dependants are left. Total or partial incapacity for work—duly certified from time to time if so required by the employer—is compensated by a weekly payment not exceeding half the average weekly earnings after the second week of incapacity and not greater than one pound per week, and such payment after continuing for six months may by agreement or arbitration under the Act be redeemed by a payment of a lump sum. Many matters of procedure are not provided for in the Act, and are regulated by Rules of the Supreme Courts framed for that purpose. In Scotland the Court has passed an Act of Sederunt making such provision.

Scope of the Act.—Amongst the industrial occupations embraced by this Act are all the employments to which the notification of accident clause of the Factory Act, 1895, applies with three exceptions, namely:—

- (1) Workshops.
- (2) Laundries not using mechanical power.
- (3) Buildings exceeding thirty feet in height, in which more than twenty persons, other than domestic servants, are employed for wages.

The exclusion of the above premises was justified by the absence in them of the numerous and serious accidents which were found in the other employments to which the Act is applicable. The evidence on this head

may be conveniently presented here in Table XIII. where the number of fatal and non-fatal accidents from such places reported under the Factory Acts during 1898 are given :—

TABLE XIII.

STATISTICS OF CERTAIN EMPLOYMENTS EXCLUDED FROM WORKMEN'S COMPENSATION ACT, 1897.					
Nature of Premises.	Number of Premises.	Number of employees.	Number of fatal accidents.	Number of non-fatal accidents.	Total reported accidents.
Workshops under Factory Act of 1878	81,669	655,565	2	135	137
Factory Act of 1895 :—		(estimated)			
Workshops employing men only	17,000	70,000	...	...	...
Laundries without power	5,359	40,000 (estimated)	...	2	2
Buildings { 30 ft. high, with more than twenty hired persons other than domestic servants }	numerous, but not known.	{ numerous, but not known }	3	164	167
		Total	5	301	306

It will be observed that the proportion of accidents in workshops, and particularly in laundries without power and in the buildings defined, is practically negligible, and the figures for workshops during the period 1st January, 1898, to 30th June, 1899, while showing the effect of the improved accident reporting under the new notification clause of 1895 already referred to in Chapter II. are still very low. In 1898 only two fatal accidents occurred in workshops, and 137 non-fatal injuries mostly of a slight character were sustained. For the first six months of 1899 the figures were 3 and 83 respectively, while during

the first year's operation of the Workmen's Compensation Act, July, 1898, to June, 1899, 3 fatalities and 160 minor injuries in workshops were reported. The author has found in practice that very few of the non-fatal injuries in workshops result in anything approaching a fortnight's incapacity for work, and the above data go to prove that no hardship in the matter of frequent incapacitating accident, such as that pertaining to the more dangerous factory employments, attaches to handicrafts as pursued in workshops. The extension of the privileges of the Compensation Act would therefore involve no serious burden upon the above workshop and other industries for *actual compensation*, though the risk in 1898 of five fatal accidents distributed over at least one million employees and between one and two hundred thousand occupiers of small workshops and laundries, and of certain buildings, would probably lead to an expenditure many times greater on unremunerative insurance premiums, however low the latter might be fixed.

The premises under consideration here and included under the Act of 1897 consist of all factories proper under the Factory Act, 1878, and the following places under the Factory Act, 1895, Docks, Wharves, Quays, Warehouses, Building operations where mechanical power is used, Laundries using mechanical power and buildings exceeding thirty feet in height in course of construction or repair by means of a scaffolding. The number of such premises and of the persons employed therein, the nature of the trades and their distribution, have already been dwelt upon in Chapter I. The extent and degree of the accidents in the same employments have been treated of in Chapter II., the Factory Act regulations on accident and safety therein have been

described in Chapters III. and IV., and are detailed in a convenient form in Part III. of this work, while Part II. is devoted to the description and illustration of practical methods of preventing accident.

Accident in Factories under the Act.—In connection with compensation for accident it may be of interest to review the statistics of casualties in the above employments which were reported in terms of the Factory Acts during the period from 1st July, 1898, to 30th June, 1899,

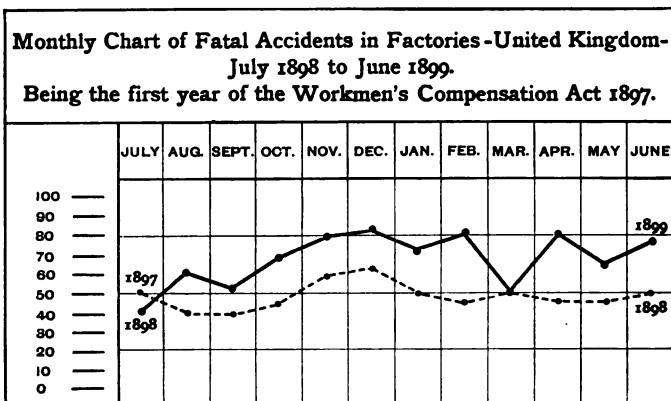


TABLE XIV.

being the first year of the operation of the Workmen's Compensation Act, 1897.

In Table XIV. the fatal accidents in all places deemed to be factories and under the Compensation Act are given for the first year of its operation.

Compared with the monthly chart for the previous twelve months, the year under consideration shows the influence of increased employment owing to the general improvement of trade which began in February, 1898, at the close of the great engineering trade dispute, and

affected all those branches of industry which contribute most largely to the Factory casualty returns. The chart it will be observed starts from a lower point in July, 1898, than it did previously, and, after an unusual rise in August, follows the normal course during the months of diminishing light until January, 1899. A second maximum is suddenly attained in February. This is followed by a very pronounced drop to the 1898 level in March, and an immediate return in April to an unusually high spring fatality rate.

In Table XV. the all-accident monthly chart in factories for the first year of the Compensation Act is given, and the disparity between it and that for the previous twelve months is very apparent. The difference is attributable to several causes already referred to in Chapter II. Better reporting year by year of minor casualties under the new notification clause of 1895 has characterised accident notification since that provision came into force, and the improvement during the first year of the Compensation Act has been most marked, employers having now a clearer understanding of the low standard constituting a reportable accident, and their attention being also drawn to the subject by the regulations and instructions of insurance undertakers.

Employees also, particularly in piecework trades, have exhibited more willingness to record accidents which formerly did not come to the notice of their employers as the cause of absence from work. The diminishing influence upon the volume of accidents during the previous twelve months of the trade dispute already mentioned must not be left out of account. This serious check upon employment affected for the greater portion of a year and for seven months of the period referred to all the industries which contribute most largely to the accident total in factories.

The lower chart in Table XV. indicates the combined monthly totals, during the first year of the Compensation

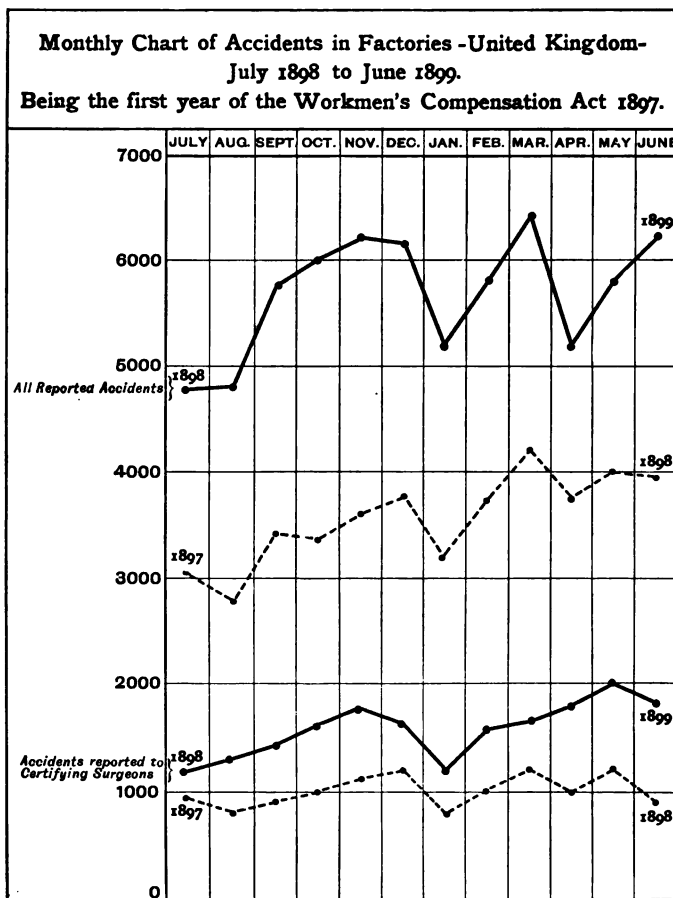


TABLE XV.

Act, of the fatalities in factories and the non-fatal injuries

from causes requiring report to Certifying Surgeons as well as to H.M. Inspectors. This chart, while, from the reasons stated above, showing an increase all over on that for the previous twelve months, follows the normal course, and the total number of accidents is not out of proportion to the increased volume of trade which has characterised the period, and was absent from the twelve months with which it is compared.

The non-fatal casualties reportable to Certifying Surgeons are usually of the more serious type, and entail much longer absence from ordinary work than the inability to perform five hours of such on any one of the three days next after the occurrence which constitutes a non-fatal accident reportable under the Factory Acts.

The fact that an accident is only reportable to H.M. Inspector is, however, no sure guide to its degree, as all falls and blows resulting in non-fatal injury, however serious, are included in this category.

Accident Rates in Factories under the Act.—No statistics regarding the number of persons employed about the premises deemed to be factories for limited purposes by the Factory Act of 1895 and included under the Compensation Act are available, and accident rates such as those given below for factories proper cannot be calculated.

In Table XVI., however, the number of such places where known and the number of fatal and non-fatal accidents reported to Certifying Surgeons during 1897 and 1898 are given.

It will be noted in connection with such places that, while the total of fatal accidents has slightly increased, the number of non-fatal injuries requiring reports to Certifying Surgeons has nearly doubled. This is what might be expected in premises which came under the

TABLE XVI.

STATISTICS OF CERTAIN PREMISES INCLUDED UNDER WORKMEN'S COMPENSATION ACT, 1897.									
Nature of Premises.	Number of Premises.	Number of Fatal Accidents.		Number of Non-fatal Accidents Reported to Certifying Surgeons.		Number of Non-fatal Accidents reported to Inspectors only.		Total reported Accidents.	
		1897.	1898.	1897.	1898.	1897.	1898.	1897.	1898.
Factory Act, 1895 :—									
Section 22. { Laundries with mechanical power	1401	2	...	92	158	109	57	203	215
{ Docks, wharves and quays	1751	88	89	203	305	2656	3765	2947	4159
{ Warehouses	3812	12	16	49	92	907	2415	968	2523
Section 23. { Buildings (1) With mechanical power.	Numbers variable and not ascertainable.	40	45	51	27	206	425	297	497
{ (2) Over 30 feet high with scaffolding									
Total		142	150	395	582	3878	6662	4415	7394

Factory Acts for the first time on 1st January, 1896, and have only gradually complied with the Accident Notification Clause. The inclusion of these places under the Compensation Act doubtless helped, as was the case with factories proper, to secure accurate reporting of accidents. The Laundry risk it will be seen is by far the smallest. The two deaths in 1897 were caused by the same accident—the bursting of a hydro-extractor—a very unusual occurrence, and no fatalities took place in 1898. Dock, Wharf, and Quay Accidents are spread over a large but unascertainable number of workers who are practically all male adults, and the number of deaths in that occupation in 1898—89—is the largest single contribution to the factory mortality total of the United Kingdom.

Accident Rates in Factory Industries.—As already indicated in the analysis of factory accidents in Chapter II. the totals of reported casualties in each group of textile industries are nearly in the order of the number of persons employed, but when the minor accidents are eliminated this no longer holds good. In Table XVII. Accident Rates for the Textile Industries and for the Non-textile employments in eighteen groups are given. The rates are based upon the fatalities, the non-fatal injuries requiring reports to Certifying Surgeons, the minor injuries reported to Inspectors only, during the year 1898, and the last published Annual Return of persons employed in factories. The trades are arranged in the table in the order of danger from the more serious non-fatal injuries reported to Surgeons.

Amongst Textiles, which employ 25 per cent. of the total factory workers, it will be noticed that the highest annual fatality rate—0·08 per thousand—occurs in the woollen factories, and Cotton, Worsted, and Jute follow

TABLE XVII.

ACCIDENT RATES IN FACTORIES UNDER 1878 ACT, DURING 1898.									
FATALITIES AND NON-FATAL INJURIES REQUIRING REPORTS TO CERTIFYING SURGEONS AND ALSO TO INSPECTORS ONLY.									
<i>Trades in Order of Danger from Non-fatal Injury reportable to Surgeons.</i>									
Industry carried on in the Factory. (For trades included, see groups in Tables III. and IV. in Chap. I.)	Number of Registered Factories.	Average Number of persons employed.	Number of Fatal Accidents.	Number of Non-fatal Accidents reported to Surgeons.	Number of Non-fatal Accidents reported to Inspectors only.	Accident rate per 1000 employees.			Non-fatal to Inspectors only.
						Fatal.	Non-fatal to Surgeon.	Textile	
TEXTILE.									
I. Jute	183	43,008	2	194	68	0'04	4'51		1'60
II. Cotton	3,157	532,920	35	2,319	860	0'06	4'35		1'60
III. Worsted	991	142,450	7	499	135	0'05	3'50		0'94
IV. Wool	3,200	131,685	11	434	130	0'08	3'29		0'98
V. Flax	435	108,871	1	188	34	0'01	1'72		0'31
VI. All other Textiles	1,985	118,753	3	152	72	0'02	1'28		0'60
Textile Total	9,951	1,077,687	59	3,786	1,299	All	Textile	Rate.	
						0'05	3'51		1'20

NON-TEXTILE.									
I. Wood : sawmills, carpenters	6,196	93,141	16	1,004	475	0'17	10'80	5'11	
II. Machines, engines, boilers, smiths	6,537	447,958	88	3,858	7,993	0'19	8'61	17'84	
III. Appliances, conveyances, tools	6,035	232,902	30	2,005	4,277	0'13	8'60	18'35	
IV. Metal extraction	320	34,138	33	242	512	0'97	7'11	15'01	
V. Metals : founding and conversion of	4,075	261,397	75	1,821	3,893	0'28	6'96	14'89	
VI. Ship and boat building	522	132,465	70	803	7,031	0'53	6'06	53'10	
VII. Chemicals	2,261	88,814	31	412	1,062	0'35	4'64	12'01	
VIII. Paper, printing, stationery	9,942	238,269	25	950	559	0'10	4'00	2'34	
IX. Miscellaneous articles	4,290	135,517	16	462	621	0'12	3'41	4'58	
X. Food	10,040	130,530	22	409	466	0'16	3'13	3'11	
XI. Other non-textiles	6,158	195,768	14	611	514	0'07	3'11	2'62	
XII. Drink	4,942	82,359	14	245	432	0'17	3'00	5'25	
XIII. Print, bleach, and dye works	2,638	138,769	21	383	216	0'15	2'76	1'56	
XIV. Gas	635	51,702	16	118	641	0'31	2'28	12'40	
XV. Glass	429	29,758	13	54	790	0'44	1'81	26'60	
XVI. Metal galvanising	533	18,909	2	279	243	0'10	1'47	12'85	
XVII. Clothing	2,296	228,064	3	335	116	0'01	1'47	0'50	
XVIII. Clay and stone work	3,360	125,271	27	139	294	0'21	1'11	2'34	
Non-textile Total	71,259	2,665,731	516	14,130	30,075	All 0'19	Non-textile 5'30	Rate. 11'28	
Grand Total	81,210	3,743,418	575	17,916	1 31,374	All 0'15	Factories 4'78	Rate. 8'38	

in the order named. In accident from power machinery and other non-fatal causes reportable to Certifying Surgeons, Jute is the most dangerous textile, the rate being 4.51, and is followed by Cotton, Worsted, and Wool. Non-fatal accident from other causes reportable to Inspectors only is not prominent in Textiles owing to the universal prevalence of machinery, and the rates are about equal in Jute and Cotton, and Worsted and Wool respectively. The mean textile rate for these three classes of accident are 0.05, 3.51, and 1.20 respectively.

In the non-textile factory industries the incidence and degree of the above accident risks is very considerable.

In Metal Extraction, Shipbuilding, Chemicals, and Metal Conversion, one person is killed by accident per annum in every one, two, three, and four thousand employees respectively. The industries named are not so remarkable for machinery risk as for serious and fatal falls of persons and material, and burns. Most of the other non-textile fatality rates are much higher than in textiles, and the mean death-rate is nearly four times as great.

In non-textile non-fatal accident reportable to Certifying Surgeons, Sawmilling and Carpentry industries, notable for their very dangerous power machinery, head the list with the high rate of 10.8 per thousand. Engineering, Appliance Making, Metal Extraction, Conversion, Shipbuilding, and the other occupations follow in the Table in their order of danger from this class of accident, the mean rate being 5.30.

Non-fatal injuries from other causes reportable to Inspectors only are very differently distributed. Shipbuilding with its many falls of material, persons, and tools, occupies an unenviable first place with over 53 accidents per thousand operatives, while Glass, Ap-

pliances, Engineering, Metal Extraction, Conversion, Galvanising, and Gas, and Chemicals follow in the order named, and are all above 12 per thousand. In the remaining nine trade groups accident of this description is neither great nor serious. The mean rate in this class for all non-textiles is 11·28 and the All-Factories rate for the above three classes of accident is 0·15, 4·78, and 8·38 respectively.

A Year's Operation of the Act.—In concluding this account of the nature and incidence, so far as factories are concerned, of an important and far-reaching addition to the legislation on employers' liability for accident, several features of its first year's operation call for notice.

The period was one of exceptional activity in factory enterprise, and opportunities for employment abounded, particularly in the more dangerous metal working occupations where day and night work prevailed. The number of reported fatalities during the twelve months—July, 1898, to June, 1899—in places classified as factories was 837, and the non-fatal injuries in the same numbered 67,469. About one-third of the latter was reportable to Certifying Surgeons. Notwithstanding the numerous adverse opinions expressed during the last two years as to the probable value of the measure, the benefits in relief from actions at law, and pecuniarily, which it has conferred on three and three-quarter millions of operatives in ordinary factories, and also upon half as many workers in mines, quarries, docks, railways, and other places, are very real and extensive. They have, however, been largely overlooked owing to the remarkable facility with which the great majority of claims have been settled extra-judicially, and the very general abstention from recording such agreements in the County Courts.

Several hundred official medical referees have been

practically unemployed, gloomy forecasts as to malingering and economic friction have not been fulfilled, and certified schemes of compensation have been adopted in only a few cases in preference to the Act.

On the other hand it is the comparatively small but unsatisfactory aspects of the Statute which have obtained publicity, for its interpretation in the relatively few disputed cases has revealed anomalies and difficulties which call for amendment.

Owing however to the novel principle of the measure and the absence of experience in dealing extensively on such lines with complicated questions of work, wages, and dependency in connection with fatal or incapacitating accident, the Act was necessarily limited in scope and more or less experimental. The important part which is specifically assigned by the measure to the *locus* of the accident has been sometimes overlooked, during the first year, in the expectations formed of it. Compensation depends upon a person being at work in a certain place when injured, and therefore no trade, as such, is absolutely included.

The individual cases of non-inclusion of persons ordinarily at work within the curtilage of a factory have, however, been very few in comparison with the large number of casualties clearly falling within the scope of the Act, and the great majority of the latter were not previously remediable by any of the actions at law described in the last chapter.

The exceptions have chiefly arisen in connection with the phrasing and undefined terms of Section 23 of the Factory Act of 1895, by which certain premises—Docks, Warehouses, Building operations, etc.—were brought for the first time under accident and other regulations. This clause has, in the case of such of the premises as

were included in the Workmen's Compensation Act, been a fruitful source of contention, and has operated more or less arbitrarily. Most of the opinions required under the Act from the Superior Courts have been connected with this matter, though the fatal injuries—177—sustained at such places were only 21 per cent. of the factory mortality during the first year of the Act, and the non-fatal casualties—8843—were but 13 per cent. of the factory total in the same time.

From actual data for the above period on the duration of incapacity owing to accident amongst 10,000 employees in each of the industries contributing most largely to the accident total, the author estimates that over all, in factories alone, 60 per cent. of the non-fatal casualties reported to Certifying Surgeons and 40 per cent. of those notified to Inspectors only, prevented the earning of full wages for more than two weeks. This implies that compensation was payable under the Act during the first year of its operation in no less than 32,000 factory casualties, of which 837 were fatalities. During the same period the number of judicial arbitrations in connection with factory accident throughout the United Kingdom was between 300 and 400. Assuming the higher figure it will be seen that the proportion of such claims brought before the courts was only 1·25 per cent. of the above total. Such conclusions confirm the many individual experiences of absence of friction in the application of the Act, and prompt settlement of claims by employers and insurance undertakers. These results are in striking contrast to the costly legal proceedings—about 1000 in number—which are annually instituted at Common Law and the Employer's Liability Act, 1880, throughout the Kingdom in connection with factory accident, and many of which are unsuccessful.

Altogether the Statute under review, though requiring obvious amendment, has, in the first year of its operation, attained results of a most gratifying character, and has proved a great boon to the industrial classes.

It has also placed factory occupiers and numerous other employers upon a common footing in the treatment of temporary or permanent incapacity of operatives owing to accident, and has by its specific compensation, provisions, and procedure largely relieved the former of the uncertainty and expense of the numerous actions-at-law which would have resulted from an extension of employers' liability on the lines of the previously existing legislation.

CHAPTER VI.

THE CAUSES OF FACTORY ACCIDENT.

BEFORE dealing with the practical aspects of the prevention of accident in factories, it is desirable to form some idea of the origin of the casualties which, in a single year of peaceful industrial life, result in over 700 deaths and 57,000 injuries, totals far exceeding the killed and wounded of a great campaign even after due allowance for the minor non-fatal injuries is made. In the administration of the Factory Acts, as we have seen in Chapter III., provision is made in the statutory accident reports from occupiers of factories, and in the reports prescribed in the cases requiring investigation by Certifying Surgeons, for such particulars as to the cause of injury as will enable Her Majesty's Inspectors to have definite information on this head. Thereafter by special inspection in selected cases the latter can decide whether the statutory requirements as to safeguarding, safe-construction, or safe-working have been complied with. A few of the outstanding causes of accident are treated of here.

Ignorance.—In spite of the facilities now afforded to all for the acquisition of some knowledge of mechanical principles, the author has found some occupiers and foremen of factories and many of the workpeople to be grossly ignorant of the nature of the forces and mechanical arrangements which it is in their power either to control, or to set free with resulting danger, and accidents from this cause are generally very serious in their

consequences. Only a few examples out of many can here be given. Several deaths were caused not long ago by ignorance of the fact that there is a limiting safe speed of rotation for each material of construction due to the stresses set up by centrifugal force when a body is rotated at a high velocity. In one case, under the direction of the occupier of a factory, fifty pieces of wood

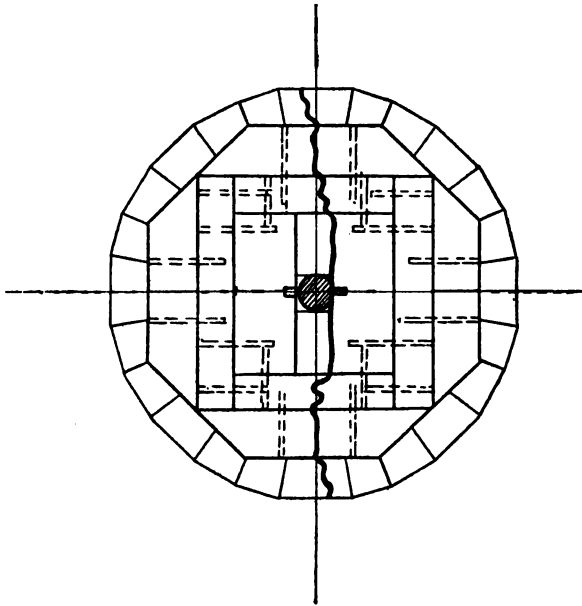


FIG. 1.

18 in. in length were built round a shaft to form a cylinder of the same diameter (Fig. 1), the binding material radially being nails and merely *glue* at the circumferential joints. This crude structure, intended for a carpenter's sand-papery machine, was actually set revolving at a speed of 700 revolutions or a linear velocity

at the circumference of 3200 feet per minute, a speed never attempted in ordinary practice except with the most carefully balanced and designed steel parts. The drum burst, in consequence, in a short time into two pieces, one of which killed an employee in its flight. The author found the stresses set up by centrifugal force, at the speed named, in this comparatively small structure to be equal to a force of $1\frac{1}{4}$ tons tearing the drum asunder, and the occupier responsible for the accident

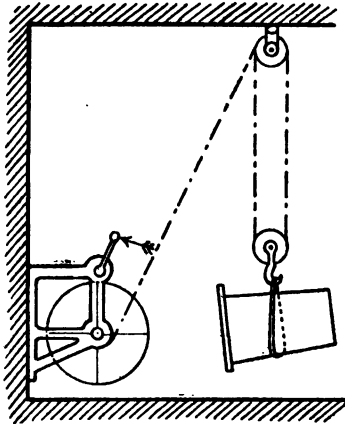


FIG. 2.

appeared to be totally ignorant of the danger he had created. In a second case a heavily loaded *hand-winch* (Fig. 2) in a boiler factory, which with its tackle had a mechanical advantage of 87, was allowed to run down under the pull of the load, when the crank handle of sound wrought iron 1 in. in diameter broke off under a stress of at least 20 tons per square inch owing to the high velocity, and killed a workman in its flight. A survey of other winches and hand-cranes, not so highly

geared, in the same factory, revealed the fact that, through the same practice of allowing crank handles to attain too great a velocity, nearly all the latter were deflected outward owing to the excessive centrifugal stress to which they had been subjected. In both these fatalities, and in others of a similar kind which might be cited, workmen and managers alike attributed the accident to *weakness* of the material owing to its dimensions, and could hardly be persuaded that adding *weight* to the part concerned would in no way increase its resistance to such stresses. Ignorance of mechanical arrangements is also found amongst workmen. A skilled fitter, for

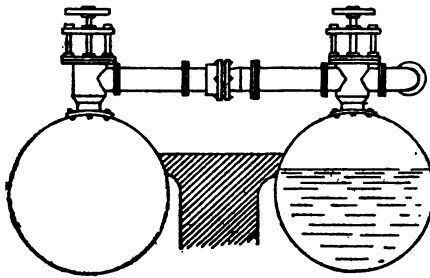


FIG. 3.

instance, in executing some boiler repairs (Fig. 3), removed a length of steam piping, and, closing the remaining length which entered an expansion joint on the boiler stop valve, with a blind flange, turned on the steam. The unbalanced pressure acting on the area closed by the flange shot the expansion length out of its socket like a projectile. The latter carried away mountings in its flight, caused explosion, and spread death and destruction around. This skilled tradesman did not apparently know the construction of a simple expansion joint. In another case an engine-keeper of long experience in a

rolling mill was called to stand by and control his engine temporarily by hand at the throttle valve owing to a breakdown in the governor gear. The operation was a new one to him, and during a lengthy piece of rolling requiring full power he left the engine to look at some pumps without realising the nature of the trust imposed upon him. The engine was relieved of its load a few seconds before he returned, and, quickly attaining an enormous speed, burst its huge fly-wheel under centrifugal stress and caused serious loss of life and property. A last example may be cited in which four men were engaged testing under steam the joints of a thin, shallow cast-iron box. A safety valve permitting a pressure of a few pounds above the atmosphere was fitted. The foreman, objecting to the cloud of vapour caused by the action of the valve, jammed it, with the result that the weak structure flew to pieces in a few seconds under the full boiler pressure and all the men were killed. Accident from ignorance is not confined however to the above classes of fatal injury to male adults. Want of knowledge of the dangers involved in interference with various moving parts and other plant in all classes of machinery and a familiarity with them which is no safeguard are fruitful sources of injury. The author has often remarked the entire absence in many cases of any attempt to secure greater caution by a little judicious instruction. A pleasing exception came under his notice in connection with a large textile factory where several hundreds of children were employed and educated at the works school. At the latter technical instruction was part of the school work. What a child might and might not do in the factory was taught, and each newcomer was, after instruction, only admitted into the factory on probation until the foreman certified that the necessary

knowledge for safe and efficient working had been acquired, and was being put into practice. The result was obvious from the remarkably low accident rate amongst this section of the employees.

Carelessness, sometimes combined with ignorance, sometimes sheer thoughtlessness or folly is another cause of accident from the results of which, except in the absence of statutory protections, nothing external can do much to shield the worker. The maintenance of strict discipline and the adoption of punitive measures may assist, but the cure lies in the employee's own hands, though unfortunately the consequences frequently spread to his fellow-workers. Some of the things which factory operatives do and suffer under this head and which pass under the review of Her Majesty's Inspectors would scarcely be credited by persons with a more limited experience, but the citing of them would serve no useful purpose.

Unsuitable clothing leads to accident about some machine parts which cannot be fenced, and which the necessities of the work require operatives to approach. The ragged sleeve ends, loose cravat, and jacket of an untidy machinist have again and again caught upon parts in motion and caused serious and even fatal injuries, while not a few survivors have to thank the inferior strength of the usual overall or dust jacket for escape. Female operatives with flowing hair lay themselves out for dangerous contact with belts, spindles, and other parts, when tying it up or confining it in a net would give perfect security. The dress of females also in factory work should be as simple and close fitting as possible.

Insufficient lighting is a source of accident, particularly of serious and fatal falls. Her Majesty's Inspectors

receive a maximum of accident notices towards the close of the year, and in all the monthly charts of accidents already given in this work it will be observed that the highest point is usually reached during the months of diminishing light. The influence of the duration of natural light in working hours on fatal and serious accident in factories is specially notable in the engineering, founding, shipbuilding, and dock employments, where operations have to be carried on within large spaces, often entirely in the open air, and which are not easily illuminated artificially. In factory buildings not well situated in this respect the thorough carrying out of the sanitary limewashing regulations of the Acts and the repetition of such even within the year will be found to materially increase the light, the diffusion of which depends very much upon the provision of a sufficient number of moderately white reflecting surfaces. Great improvements in the condition of dark engine-rooms and portions of factories entirely walled up can be made by attention to this matter, while in many cases considerable saving is effected in the outlay on artificial illuminants.

Defects of Machinery and Structures contribute to a number of casualties. Amongst these may be mentioned bad belting, pulley and toothed gears, shafting and journals, collars and couplings, weak, badly designed, or overloaded parts of machinery, plant and staging giving way, worn out ropes and damaged or unannealed chains breaking, faulty grindstones flying, bursting of jacketed steam pans, and other closed vessels under pressure but without safety valves or periodical inspection. In certain classes of factories also the staging, gangways, stairs and other structures are more or less of a temporary character, and necessarily undergo rapid deterioration

and require frequent renewal and repair to ensure safety.

Absence of Safeguards is the last cause of accident to be mentioned, and, from the present point of view, the most important. In this direction there are great possibilities. The statutory regulations on the subject have already been summarised in Chapter III., and are detailed in Part III. of this work, while the practical observance and illustration of these provisions is the subject of Part II. It should be noted that the Superior Courts have decided that neither contributing carelessness nor thoughtlessness on the part of a worker is any barrier to the penal and some of the civil consequences which may follow a neglect to fence machinery or plant whereby an accident, otherwise impossible, has occurred.

Though industrial life is characterised by a steady extension of the factory system of production and a progressive use of all forms of mechanical power, Her Majesty's Inspectors of Factories are not without hope that accidents from the above cause at least will soon become rare. To a large extent the injuries still inflicted by unprotected machinery are caused by failure on the part of occupiers to consistently carry out in regard to *all* parts of machinery and plant the sufficient and suitable safeguarding provision which they have already provided at some of them. This is particularly noticeable in a number of large factories where it is possible in almost every detail of non-compliance to cite examples of what should have been done from other well-guarded parts under the same roof. The cause of this is generally the absorption of the management in the work of production and the failure to assign the safeguarding of machinery and maintenance of such as a definite duty to some responsible party. The whole object of the statu-

tory provision is "Prevention" not "Cure," and no amount of hasty and often inefficient protection erected *after* some terrible accident can take the place of wise forethought and deliberate action based thereon.

Causation of a Year's Accidents.—It is possible after sufficient time has elapsed from the close of any given year to analyse the accident reports for the period, and in Table XVIII. the 57,423 reported casualties in factories during the year 1898 have been classified according to industry, causation, and result for Textiles, Non-textiles, and the Employments brought partially under the Acts in 1895. The fatalities and injuries reported to Certifying Surgeons as well as Inspectors have also been distinguished from the generally less serious non-fatal accidents required to be reported to Inspectors only, and the industries are arranged in the order of their accident total.

From the table it will be noted that in the Textile Factories, where machinery reigns supreme, 44 per cent. of the total fatal accidents and 98 per cent. of the non-fatal injuries requiring reports to Certifying Surgeons were caused at parts of machinery in motion by mechanical power, and a number of these accidents were without doubt due to preventable causes such as absent or inefficient safeguards, or failure to secure the observance of the statutory provisions regarding safe-working and safe-construction. The other fatal accidents were caused chiefly by falls of persons and of material, while the remaining 2 per cent. of non-fatal serious injury was divided between accidents from hot liquid in vats or pans, explosion, and escape of steam, and in this section also some degree of prevention was possible by conforming to the spirit of the statute.

Over all the non-textile factories, where as we have seen the accident totals and accident rates are by far the

TABLE XVIII.

REPORTED ACCIDENTS IN FACTORIES, 1898—CLASSIFIED ACCORDING TO INDUSTRY AND CAUSATION.																		
Industry carried on in the Factory. (For trades included see same headings in Tables III. and IV., Chap. I.) F., Fatal; N., Non-fatal.				Accidents reported to Certifying Surgeons as well as to H. M. In- spectors (all fatal accidents and the non-fatal from undernoted causes).										Accidents reported to H. M. Inspector only (all other non-fatal accidents).				
				Machinery.		Hot liquid or molten metal, or other sub- stance in vat or pan.		Explosion.		Escape of gas, steam, or metal.		Falls.		Other causes, chiefly scalds, burns, and injuries from material, structure and tools.		Machinery not moved.	Falls.	Scalds, burns and injuries from material, structure and hand tools.
				F.	N.	F.	N.	F.	N.	F.	N.	F.	N.	F.	N.	N.		
TEXTILE.				19	2,297	3	1	6	1	13	7	7	51	279	530	
I. Cotton . <td>1</td> <td>487</td> <td>...</td> <td>...</td> <td>2</td> <td>...</td> <td>3</td> <td>...</td> <td>7</td> <td>3</td> <td>2</td> <td>52</td> <td>81</td>				1	487	2	...	3	...	7	3	2	52	81		
II. Worsted . <td>3</td> <td>417</td> <td>...</td> <td>...</td> <td>8</td> <td>...</td> <td>2</td> <td>...</td> <td>7</td> <td>3</td> <td>6</td> <td>58</td> <td>66</td>				3	417	8	...	2	...	7	3	6	58	66		
III. Wool . <td></td> <td></td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>1</td> <td>1</td> <td>1</td> <td>24</td> <td>43</td>						1	1	1	24	43		
IV. Jute . <td></td> <td></td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>4</td> <td>11</td> <td>19</td>						4	11	19		
V. Flax . <td></td> <td></td> <td>...</td> <td>...</td> <td>...</td> <td>1</td> <td>1</td> <td>3</td> <td>...</td> <td>2</td> <td>11</td> <td>17</td> <td>44</td>						1	1	3	...	2	11	17	44		
VI. Other Textiles . <td>1</td> <td>146</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td> <td>...</td>				1	146		
Textile Total . <td>26</td> <td>3,728</td> <td>...</td> <td>...</td> <td>14</td> <td>2</td> <td>14</td> <td>1</td> <td>30</td> <td>16</td> <td>14</td> <td>441</td> <td>783</td>				26	3,728	14	2	14	1	30	16	14	441	783		
NON-TEXTILE.																		
I. Machines, engines, boilers, smiths				42	3,463	3	2	113	...	89	1	193	26	14	424	1261	6308	
II. Ship and boat building .				14	776	...	1	9	...	10	...	8	47	8	180	1592	5595	

III. Appliances, conveyances, tools	8	1,848	...	2	71	2	32	1	54	5	12	80	545	3,652
IV. Metal founding and conversion	48	1,270	...	...	331	3	81	3	89	6	15	132	654	3,107
V. Paper, printing, stationery	15	903	1	1	18	...	12	...	17	6	2	87	142	330
VI. Chemicals	8	238	1	3	89	5	34	...	51	5	9	40	243	779
VII. Wood : sawmills and carpenters	7	988	...	...	4	...	10	1	2	2	6	50	54	371
VIII. Miscellaneous articles	6	440	1	4	9	...	7	...	7	3	2	24	125	472
IX. Glass	5	39	...	...	1	2	7	...	7	1	5	6	107	677
X. Food	11	355	...	...	32	...	12	1	10	8	2	27	109	270
XI. Metal extraction	17	119	...	3	71	1	34	1	12	7	4	19	97	396
XII. Gas	9	79	...	1	7	1	20	1	18	3	1	8	196	437
XIII. Drink	2	75	...	3	10	...	150	...	10	4	5	8	122	302
XIV. Print, bleach, and dye works	12	325	...	5	31	2	13	1	14	1	...	8	79	129
XV. Metal galvanising	2	233	...	...	29	...	12	...	5	...	...	6	43	194
XVI. Clay and stone working	14	126	...	...	2	...	1	...	10	4	9	16	69	209
XVII. Clothing	2	330	...	...	1	...	3	...	2	...	...	12	16	88
XVIII. Other Non-Textiles	5	580	...	1	11	...	15	...	5	6	2	53	105	356
Non-Textile Total.	227	12,187	6	27	888	16	542	10	513	134	96	1180	5559	23,336
FACTORY ACT, 1895.														
Employment at—														
I. Docks, wharves, quays.	26	302	...	...	...	...	1	...	2	45	18	48	999	2,718
II. Warehouses.	6	91	...	...	...	...	1	...	...	7	3	38	610	1,767
III. Buildings, construction, sect. 23														
(1b) (2a)	3	26	...	...	...	...	...	1	1	29	9	4	177	244
IV. Laundries using mechanical power	...	153	...	...	4	...	1	...	...	...	...	7	13	37
V. Buildings in use, sect. 23 (2b)	1	...	...	...	...	...	1	...	...	2	...	2	52	109
1895 Act } Total.														
Employments }	36	572	...	...	4	...	4	1	3	83	30	99	1851	4,875
Grand Total . . .	289	16,487	6	27	906	18	560	12	546	233	140	1354	7851	28,994

highest, 44 per cent. of the deaths occurred in connection with power machinery, and of the non-fatal injuries reported to Surgeons 86 per cent. was due to the same cause, thus providing a large field for improved safety provision in connection with machinery risks alone.

It is instructive to note the distribution of the various causes of accident amongst the principal non-textile trade groups.

Engineering, Boilers, Smiths, and Machine making—No. I.—with casualties of nearly 12,000—almost 27 per cent. of the non-textile total—had 90 per cent. of its non-fatal injuries reportable to Surgeons caused by power machinery, and in the groups following—II. to XVIII.—the rate from the same source is as follows: Shipbuilding 96, Appliances 92, Metal founding and conversion 70, Paper trades 95, Chemicals 58, Sawmills and Carpenters 98, Miscellaneous Articles 95, Glass 72, Food 86, Metal extraction 49, Gas 67, Drink 30, Bleach Works 95, Metal finishing 83, Clay and Stone 90, Clothing 98, and other non-textiles 95.

The non-textile fatal accidents are somewhat differently distributed. In Engineering 48, Shipbuilding 20, and in Appliance Making 26 per cent. of the deaths occurred at power machinery, and in the above remaining fifteen groups of non-textile industries the proportion of mortality due to mechanical power is generally higher, being 64, 60, 26, 44, 38, 39, 50, 51, 56, 14, 57, 100, 51, 66 and 35 respectively. In the Bleach, Chemical, and Smelting industries, Vats, Explosions, and Escape of Gas or Metal accounted for 38, 26, and 15 per cent. of their respective mortality total, while the fatality proportion, due chiefly to falls of persons and of materials, structures, and tools, is specially noticeable in Engineering 45, Shipbuilding 78, and Appliance Making 56 per cent.

In the employments brought under the Acts in 1895 practically all the non-fatal accidents reported to Surgeons during 1898 occurred at machinery moved by mechanical power. No fatalities occurred in laundries, one fatal scald was received from steam in building construction, and all the other deaths occurred through power machinery, falls from staging and buildings, and blows from falling material, structures, and tools.

The falls of persons and articles referred to naturally bulk largely in such trades, the mortality proportions from these causes being for labour at Docks, Wharves, and Quays 70, Warehouses 62, and in Building operations under the Acts 90 per cent.

Altogether 289 persons were killed and 16,487 injured during 1898 by Mechanical power machinery. Hand-power machinery caused 6 deaths, and Vats 27 fatalities, all in non-textile factories, 18 and 12 lives were lost by explosion, and escape of gas, metal, or steam respectively, while 373 workers—chiefly male adults and forming 51 per cent. of the whole factory mortality—met their deaths by falls from staging and ladders, and blows from falling material, structures, and tools.

Workshop casualties, which, from their very small number in relation to the total employees, have been omitted from the tables in this work, were during 1898 distributed as follows. Amongst a workshop population of about three-quarters of a million, 139 accidents occurred. Two only of these were fatal and were caused by falls in clothing and appliance workshops. Fourteen non-fatal injuries from hand-power machinery—one in a laundry—were sustained, and the others each in a separate trade; 1 vat accident in a laundry, 26 injuries from falls, and 96 chiefly from cuts and blows from falling material, structures, and tools.

TABLE XIX.

CAUSATION OF THE REPORTED ACCIDENTS IN FACTORIES, 1898. AT MACHINERY MOVED BY MECHANICAL POWER.													
Industry carried on in the Factory. (For trades included see Tables III. and IV. in Chap. I.) F., Fatal; N., Non-fatal.	Prime movers, millgearing, and dangerous machine details.		Cranes and other lift- ing tackle.		Hoists.		Circular saws.		Grind- stones.		Shuttles.		
	F.	N.	F.	N.	F.	N.	F.	N.	F.	N.	F.	N.	
TEXTILE.													
I. Cotton	11	2,145	2	4	5	53	...	5	...	5	1	85	
II. Worsted . . . . .	...	444	...	1	1	20	...	1	...	...	...	15	
III. Wool	3	392	...	3	...	12	...	...	...	2	...	8	
IV. Jute	1	182	...	4	...	1	...	1	...	...	...	5	
V. Flax	1	170	...	2	...	5	...	4	...	...	...	7	
VI. Other Textiles . . . . .	...	134	...	1	...	6	...	...	...	1	1	4	
(Divisions VI. to XII., Table III., Chap. I.)													
Textile Total	16	3,467	2	15	6	103	...	11	...	8	2	124	
NON-TEXTILE.													
I. Machines, engines, boilers, smiths	25	2,849	9	207	3	26	...	168	5	213	...	...
II. Ship and boat building	5	614	9	75	...	1	...	62	...	24	...	...
III. Appliances, conveyances, tools	7	1,867	11	64	...	16	...	120	...	81	...	...
IV. Metal founding and conversion	36	1,931	...	179	1	5	...	32	...	23	...	...
V. Paper, printing, and stationery	12	864	...	12	3	15	...	8	...	4	...	...
VI. Chemicals	8	186	...	22	...	14	...	13	...	3	...	...

VII. Wood : sawmillers and carpenters . . .	3	455	2	10	...	8	2	517	...	6	...	...
VIII. Miscellaneous articles . . .	2	345	1	9	3	3	...	72	...	6	...	...
IX. Glass . . .	4	31	...	...	...	3	...	1	...	4	...	...
X. Food . . .	10	303	...	18	1	24	...	8	...	2	...	...
XI. Metal extraction . . .	15	97	1	16	1	3	...	3	...	...	...	...
XII. Gas . . .	8	46	1	30	...	...	...	...	...	1	...	...
XIII. Drink . . .	2	65	...	4	...	5	...	1	...	...	...	...
XIV. Print, bleach, and dye works . . .	12	293	...	3	...	18	...	9	...	2	...	...
XV. Metal galvanising . . .	1	220	1	3	...	3	...	2	...	5	...	...
XVI. Clay and stone working . . .	11	115	2	7	1	2	...	1	...	1	...	...
XVII. Clothing . . .	1	321	1	3	...	5	...	1	...	...	...	...
XVIII. Other Non-Textiles . . .	2	452	...	8	...	9	3	107	...	4	...	...
(Divisions XII., XV., XVIII., XX. and XXII. to XXVI., in Table IV., Chap. I.)												
Non-Textile Total . . .	164	9,854	40	670	13	157	5	1127	5	379	...	...
FACTORY ACT, 1895.												
Employment at—												
I. Docks, wharves, and quays . . .	7	53	19	246	...	3	...	...	...	...	...	...
II. Warehouses . . .	1	26	...	48	5	17	...	...	...	...	...	...
III. Buildings, construction, and repair . . .	1	14	2	8	...	2	...	1	...	1	...	...
IV. Laundries using mechanical power . . .	...	151	...	...	...	2	...	...	...	...	...	...
V. Buildings in use . . .	...	...	...	...	1	...	...	...	...	...	...	...
1895 Act } Total	9	244	21	302	6	24	...	1	...	1	...	...
Employments }												
Grand Total . . .	189	13,565	63	987	25	284	5	1139	5	388	2	124

Accidents due to Special Causes.—Particular attention has been paid of late years to the deaths and injuries caused by certain dangerous parts of machinery and processes, and an analysis of the causation of the 16,776 mechanical power fatalities and non-fatal injuries in factories during 1898 is given in Table XIX. for the various employments.

The increased powers conferred upon Her Majesty's Inspectors of Factories by the Factory Act of 1891, for dealing with "all dangerous parts of the machinery," and the obligation of occupiers to securely fence such, in addition to the parts specified by the Acts as requiring to be absolutely protected, have been already discussed in Chapter III. Such provisions both under the Statute and by Special Rules and requirements have resulted in much benefit to factory operatives.

Amongst the selected dangerous parts in Table XIX. flying shuttles have hitherto been the cause of fatality and of serious injury particularly to the eyes. Circular saws it will be seen annually claim a large number of fingers and portions of the hands as well as some lives; flying grindstones also inflict serious bodily and even fatal injury, while defective construction, manipulation, and absence of safeguards at hoists, cranes, and other lifting tackle cause a loss of nearly a hundred lives per annum besides bodily injury to about 1300 persons.

An analysis is given in Table XX. of 170 accidents which were reportable within a given area to an Inspector and to Certifying Surgeons during 1898.

In the next chapter the subject of practical safeguarding is entered upon, and in the course of Part II. methods of preventing accident from the above and many other causes are explained and illustrated.

TABLE XX.

ANALYSIS OF ONE HUNDRED AND SEVENTY ACCIDENTS REPORTED TO INSPECTOR AND CERTIFYING SURGEON—1898.					
Industries.	Fatal.	Non- fatal.	Parts causing injury.	Fatal.	Non- fatal.
Aërated waters	2	Band saws . . .	...	3
Bakers	7	Belts . . .	...	13
Bobbin turners	1	Circular saws . . .	...	22
Boilermakers . . .	1	2	Cranes . . .	...	15
Cabinetmakers	3	Engines . . .	...	3
Candle makers	1	Escape of metal . . .	...	2
Carriage makers	1	Escape of steam . . .	...	2
Comb makers	14	Falls . . .	1	...
Coopers	3	Fans . . .	...	1
Cotton spinners	3	Fly-wheels . . .	...	2
Distillers	2	Iron planers . . .	...	1
Envelope makers	2	Knives . . .	...	4
Engineers	24	Lathes . . .	...	3
Fancy-box makers	1	Lifts . . .	...	5
Fish-oil refiners	1	Machine : self-acting . . .	...	25
Flax spinners	3	Machine : breaking . . .	2	...
Grain millers	1	Machine : oiling . . .	...	8
Granite polishers	9	Main shafts . . .	...	3
Ironfounders	2	Pinions . . .	...	10
Joiners . . .	1	9	Pulleys . . .	...	2
Jute spinners	3	Pulp beater . . .	...	1
Laundries	4	Rollers . . .	...	15
Letterpress printers	3	Shafts . . .	...	4
Lithographers	4	Shuttles flying . . .	...	1
Locomotive makers	14	Spindles . . .	...	4
Oil-cake makers	2	Stamping presses . . .	...	7
Packing-case makers	2	Steam hammers . . .	...	2
Paper makers	18	Wood planers . . .	...	6
Preserve makers . . .	1	5	Work flying . . .	...	3
Sawmillers	6			
Shipbuilders	6			
Shipping wharves	3			
Tinplate workers	1			
Wool spinners	5			
	3	167		3	167

PART II.

THE PREVENTION OF ACCIDENT.

INTRODUCTION.

IN entering upon the discussion and illustration of the practical safeguarding, safe-working, and safe-construction of factory machinery, plant, and premises which are involved in accident prevention, it is necessary that a distinct idea should be formed of the legal and practical incidence of the responsibility for attaining this desirable object.

The legal obligation has been described in Chapter III., is detailed in the consolidated text of the Law in Part III. of this work, and may be briefly summarised for the present purpose.

The occupier of a factory or workshop is generally responsible under the Acts for the observance of all statutory provisions of the above nature except those devolving upon workers under Special Rules, fire-escape provision which falls upon owners, and tenement factory conformity which is shared in a specified manner between owner and occupier. Where the actual offender is some other person than the occupier, the latter, when charged, may on proof of having exercised due diligence to enforce the execution of the law, or, on previously satisfying an Inspector upon this point, have such other person con-

victed in his stead. For most practical purposes, however, under the Factory statutes, the alleged acts, neglects, and defaults of works managers, overseers, foremen, and servants are charged upon the employer, and escape from liability under the above provision is seldom attempted.

In view of the considerable devolution of administrative responsibility which obtains in all great industrial concerns and of the frequent entire absence in large corporations and limited liability companies of the element corresponding to the personally interested occupier, special care in the rules and practice of such firms must be taken to instruct their agents. As a matter of fact the practical working out of the statutory regulations on accident, safety, and labour depend for their success on the degree of intelligent interest which occupiers, general managers, and subordinates take in the matter.

In this connection it is necessary to emphasise the fact that the existence of Inspectors of Factories and their occasional visits in no way relieve occupiers of responsibility. Such officers possess no general commission. Their powers are strictly limited and defined by the Acts, and, except in the matter of one or two special branches and a few administrative details referred to in the statutes, their duties are prescribed by the Secretary of State to whom they report.

Her Majesty's Inspectors of Factories are primarily appointed in order that the Secretary of State may be kept informed from time to time of the manner in which certain statutes relating to Factories and Workshops are being observed, and to secure that observance in cases of default or neglect by advisory, cautionary, or punitive measures as the circumstances may demand.

Apart from the superior headquarters and divisional

officers, *viz.*, H.M. Chief Inspector of Factories and H.M. Superintending Inspectors of Factories who supervise the Inspectors, and certain of the latter with special duties, the country is divided for ordinary administrative purposes into forty districts with geographical boundaries, of each of which one Inspector is in charge, in most cases unassisted, in others aided by one or more Junior Inspectors and Inspectors' Assistants.

Each occupier of a factory or workshop must within one month of beginning such occupancy send notice of the same in the form prescribed by the Acts to the Inspector for the district, and the latter then supplies an abstract of the Acts applicable to the premises, for exhibition therein, and specimens of the Accident and other Registers and papers which require to be kept.

Visits to individual Factories and Workshops are necessarily made at considerable and irregular intervals, in the case of factories about once a year. The huge annual total of accidents already detailed and other special causes naturally claim priority and often require premises to be visited more frequently, but such visits generally require to be devoted to the special matter in hand, and cannot as a rule be utilised for systematic inspections.

This very limited body of experts, whose numbers are often greatly exaggerated, has really been established to secure by the above means the *general* observance of the useful statutes, with one important part of which alone we are dealing.

The author is particularly desirous to remove from the minds of the two hundred thousand employers, and the four and a half millions of people concerned, the idea that dependence upon pressure from the above number of Her Majesty's District Inspectors of Factories can be

relied upon for the attainment of due safeguarding and safe-working of machinery and plant, or indeed for conformity to any of the other provisions of the Acts.

In an occasional survey of a factory, notice can only be taken of the actual and visible conditions of work at the time, and that merely in a general manner, whereas every practical man is aware that modifying circumstances known only to occupiers, their agents, and workmen, which are not apparent, and the existence of which is not declared, may materially affect the supposed safety of some parts.

The occupier of a factory is solely responsible under the statute for the provision and maintenance of secure fencing at every dangerous part. Also, in numerous works where machinery is used, many changes may and do take place with regard to its position and character, and each occupier is similarly responsible for the necessary modification or extension of fencing, which will bring new or altered plant into conformity.

An occupier does well, however, to avail himself of all possible assistance to be derived from the knowledge of an Inspector, and no pleasanter duty falls to the lot of such officials, who are withdrawn from interest in all other professional and industrial pursuits, than the free communication of their special experience to an intelligent and inquiring employer of labour or his representative.

In the following chapters the practical steps which, in the author's opinion, may be taken to protect, in view of possible accident, the various classes of machinery, plant, and structures, are detailed and illustrated to a considerable extent, and the application of the remedies is not limited to factories, but is equally indispensable to safety and economy in the use of machinery and plant by Con-

tractors, Mine or Quarry owners, and all other users of power.

Some degree of finality is necessarily attainable in the simpler forms of fencing about the power house, the mill-gearing, and dangerous details of machinery, and most failures to conform in these respects are due to lack of consistency and thoroughness in applying the recognised remedies.

The protection, however, at some specially dangerous machines and processes is to some extent evolutionary, and to satisfy the law it has been decided that the fencing at any part must be of the safest type known (*Schofield v. Schunck* 24 L.T. 253). Fencing in the case of the more powerful machine parts, it will be observed, is absolute. In the much larger class of machine details and operations, it is conditioned by proof of danger and, necessarily, by practicability.

The object of this portion of the present work will be served if it contributes in a small degree to the enlightenment of users and makers of machinery on the large extent to which the latter condition is capable of realisation in the daily routine of our great industrial system.

CHAPTER VII.

SAFEGUARDING OF PRIME MOVERS.

THE Law as we have seen in Chapter III. requires absolute safeguarding and maintenance of protection in a factory at every part of an engine, water-wheel, or other motor operated by steam, water, or other mechanical power, and also at every fly-wheel directly connected with any such power, and at every wheel race.

We shall now consider in detail the subject of fencing these prime movers. The latter consist at the present time of steam, gas, oil, and other heat engines, hydraulic, electric, and pneumatic motors, water-wheels, turbines, and windmills.

Engine Types.—Vertical engines used for blowing and pumping are represented by Fig. 4 in which the statutory protection in the form of rail fencing is shown. The condition of being “securely fenced” is not confined, as is sometimes assumed, merely to the *moving* parts. Any stationary portions of the structure which may cause accident through lack of fencing are equally included, and it is no defence, if protection is not afforded, that its position is such that there is no danger (*Doel v. Shepard*, 5, E. & B., 856, 25 L. J. Q. B. 124). The edges of all stairs, platforms, ladders, and stagings above the engine-room floor should be so protected whether the use of them is regular or infrequent, and service platforms and approaches of this kind, which are invariably found in large vertical and beam engines (Fig. 5) should

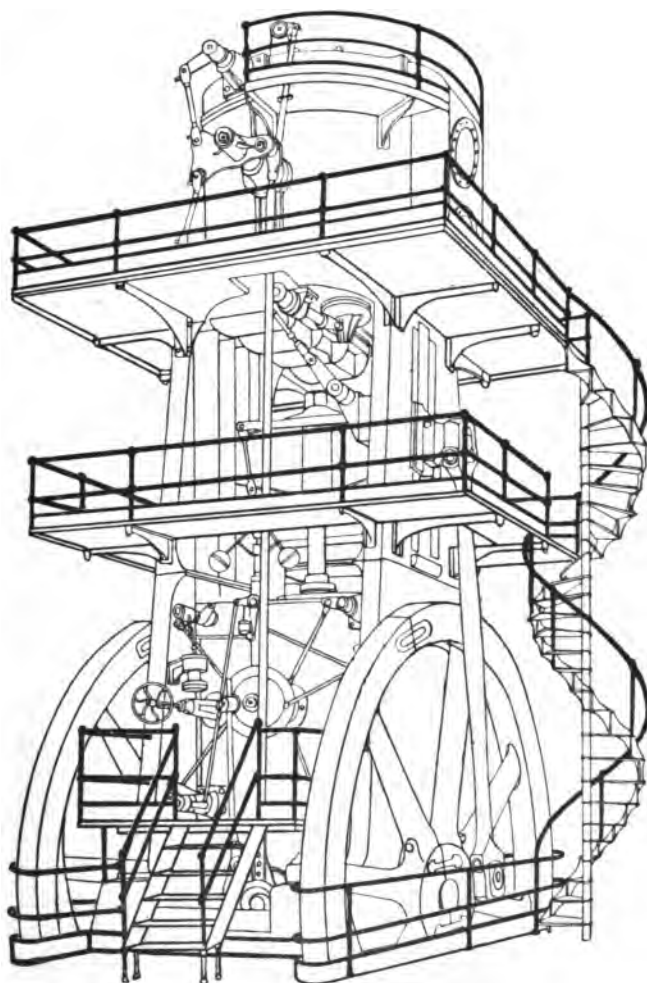


FIG. 4.

be fenced in every case both at their outer edges and at the sides nearest the machinery; *double* rails, the upper one of which should not be less than 3 ft. in height, and a fender or coaming 6 in. deep at the foot level should be used. The practice of placing such rails very close to moving parts is a bad one, and has directly led to some accidents. No low rail fencing of the type described should be within 12 inches of the nearest moving part which it is intended to fence.

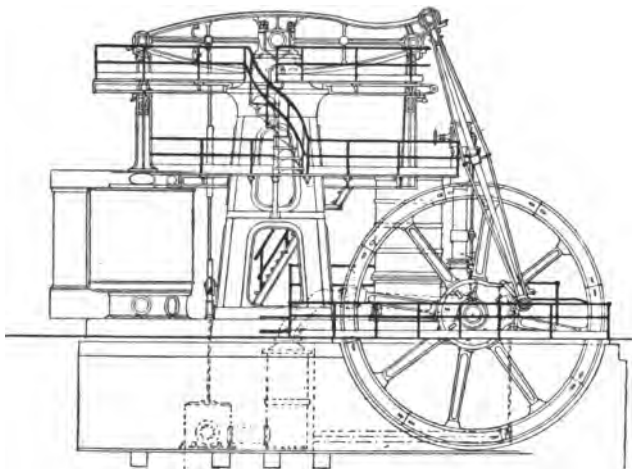


FIG. 5.

The crossheads, connecting rods, cranks, crank-pits, crank-shafts, fly-wheels, pump and other gears on floor or platform of all engines also require efficient safeguarding, and the rail type of fence may be applied to these, with the above proviso, in the manner of Figs. 4 and 5. The low coaming in addition to the upper and middle rails is important. It effectually prevents the projection of the feet and the rolling of articles into the dangerous area.

In Fig. 6 the protection of the latter parts is shown for a horizontal engine. In the case of these and similar prime movers the height of the rail fencing must be calculated from the highest point—often above the floor level in large engines—at which the attendant may have to stand in the performance of his duties. Where the fencing rises from the ordinary standing level it is never

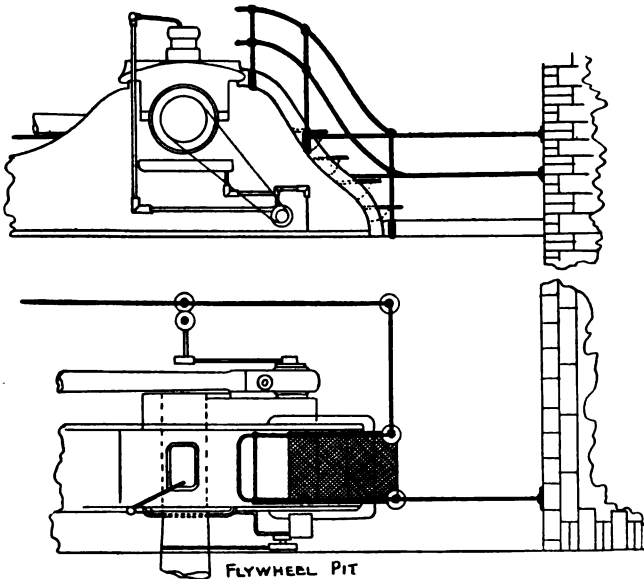


FIG. 6.

secure unless double rails and a coaming or skirting are used. The author has known quite a number of fatal and serious injuries to persons merely stunned or slightly injured by slipping or falling on engine floors, and thereafter being much more severely wounded by rolling off the floor or platform under the fence owing to the absence of the second rail. The place of the latter may

be taken by a neat metal or wirework fender at least half the height of the top rail.

Rolling mill engine protection is shown in Fig 7. In these and similar types a shield at the side of the slide block path and at the projecting ends of the piston rods is necessary, in addition to the parts already indicated.

Fig. 8 is a compound horizontal mill or electric light engine with large rope drum fly-wheel. The double rails and coaming in such a case may either be carried round each side of the rope drive when low, or, if a passage is necessary in a limited headway of this description, they can be intersected for that purpose by cross rails, in which case an open rod or other screen must be provided overhead to protect from injury by damaged ropes or belts or contact with such parts in motion. When the coaming as in Fig. 9 is a part of the engine bed, the combination serves as an oil saver, and when the crank shaft bearings are provided with separate waste oil catchers, as in Fig. 6, a rotary pump, driven by a cotton band from the shaft, can be used for automatic lubrication.

In Fig. 10 the horizontal engine fly-wheel alternator is shown with rail fencing. Such electric generators with the exception of the short drive to the small exciting dynamo are practically self-contained, while in Fig. 11 a still further advance in simplicity of parts and of fencing required is made in the enclosed vertical high-speed engine directly coupled to the dynamo with a small disc fly-wheel between.

In all such circumstances provision should be made for operating the "barring" or other manual engine turning gear from the *outside* of the statutory protection.

In some cases, particularly where the crank-shaft passes through a wall, it is possible to place the fly-wheel

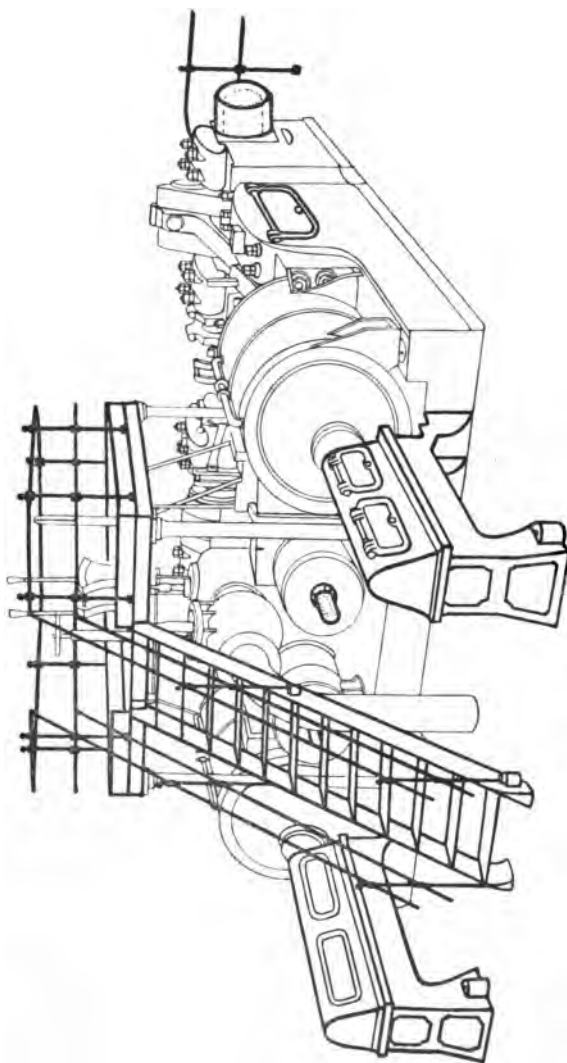


FIG. 7.

close to the latter and to encase it and any toothed or other gearing entirely with various materials. Where this is not done, care must be taken to keep the 3 ft. double rail, or other fence, well clear of every part of the wheel rim, boss, and spokes, the shear between the latter and ill-considered close rails having caused not a few deaths.

Engine safeguarding may be carried out with rails or boards of wood, with metal plate, rails or wire work, but metal fences are found to be the most durable, and in some factories, such as iron and steel mills, and metal working generally, where rough usage is to be expected, no other material is practicable. Wherever possible, the prime mover should be established in a special room, isolated from dust and from approach by unauthorised persons. The protection afforded, however, must just be as thorough where the attendant is alone concerned as in more exposed situations. Appearance is also a consideration of some importance where a valuable prime mover is well housed and otherwise well furnished. The necessity for well-lighted engine-rooms has been referred to in discussing the causation of accident and the periodical lime washing, painting, or otherwise treating the walls and ceilings of prime-mover houses is only one of a number of points which call for attention.

If an engine attendant is induced to take a pride in keeping up the appearance of the valuable piece of machinery entrusted to him, by some little initial outlay on the room interior, the effect of this upon the performance of all his duties will be salutary.

Crank overhead engines of the table or wall type have usually the fly-wheel and other moving parts out of ordinary reach, but wherever they are at any time approached in motion, fencing of the part is required,

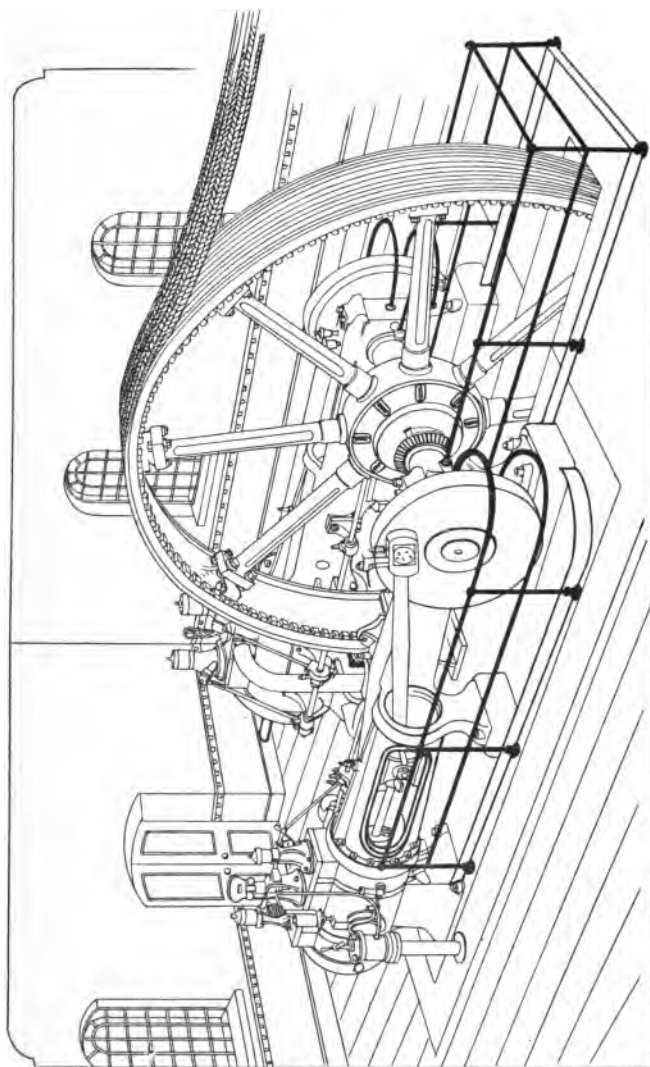


FIG. 8.

while, if low set, a close high screen of spars, wire netting, or sheet metal may be used, or a rail fence well back from the enclosed portions.

Gas and Oil engines form a class by themselves owing to the special manipulation which the most of them require. These prime movers have greatly increased in numbers during the past decade. Many small workshops have been converted into factories by the introduction of a gas engine which requires little attention, and where gas is too costly or not obtainable, a large field has been found for its rival, the oil engine. These motors are relatively small, and in most cases require ready access to the fly-wheel for starting purposes. The general custom is to build a house round the engine and more or less close to it, but such a course does not obviate the necessity for fitting the statutory secure fencing, the nature of which varies with the circumstances. Where the room is large enough, the rail and fender and other low set types of protection, kept well back from the fly-wheel, etc., will be found sufficient, and certain of the bars can be hinged for hand starting purposes (Fig. 12). Where a self-starter is fixed to the engine or a cranked handle (Fig. 13) can be used on the shaft for turning the wheel, the fencing may take the form of Fig. 14 in which a wooden frame close to the wheel is filled in with wirework, and the projecting crank shaft end has a portable box covering, or of Fig. 15, in which a friction clutch reduces the resistance to starting by a handle, and the rails are fixed. The former protection may also take the shape of a semi-circular top or a complete hoop of sheet metal filled in with wire netting or wood, and secured to the floor or engine base. When the fly-wheel has to be handled for starting and the engine space is much confined, a wirework frame or shutter the full height, of the

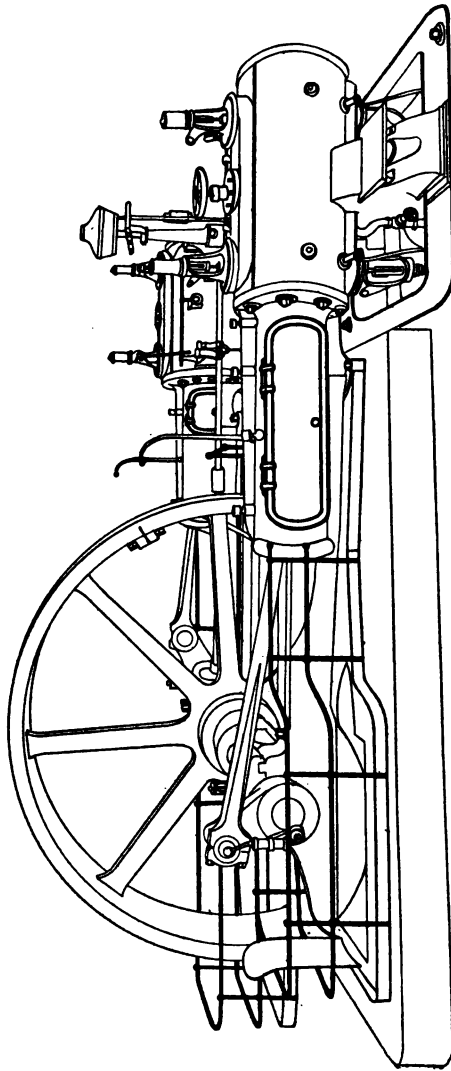


FIG. 9.

fly-wheel may be made to telescope upward or slide, or open to the side to give access (Fig. 16). The above sketches illustrate various positions of gas and oil engines in relation to the house and its entrance door, and the parts requiring fencing in the ways already discussed. It is sometimes stated by gas and oil-engine makers that the immunity from accident which they experience while having engines under test by skilled workmen in a large erecting shop, is proof that no fencing is required when they are set to work. The competition in the supply of small motors of this description is so keen that when an

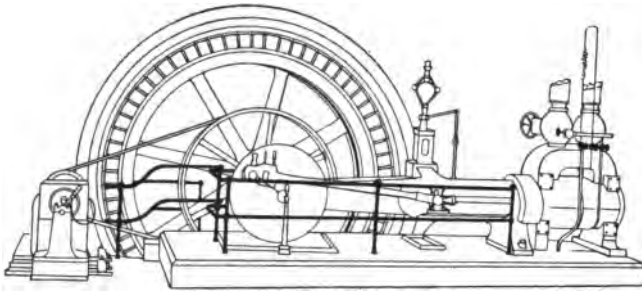


FIG. 10.

occupier purchasing one asks for fencing he is told none is required, or supplied with an inadequate and sometimes dangerous rail. On the other hand the people who use such motors are generally wholly unused to machinery which, from considerations of space, is frequently cramped up in a small compass and gives rise to accident, unless the statutory fencing is fitted. The other types of heat, hydraulic, and pneumatic engine are similarly protected.

Engine Details.—While the prime mover parts already referred to must necessarily be fenced *in loco*, there are

various details in engine design and manufacture, neglect of attention to which contributes to future accident. The position of the governor, particularly when of the low-speed heavy-ball type, is important. In one case which came under the author's notice, the balls in their widest circle only cleared the fly-wheel arms by $1\frac{1}{2}$ in. One day when the load upon the engine was suddenly relieved by the simultaneous stoppage of a number of machines, the stress upon the weak ball arms bent the latter slightly outward, with the result that a blow was

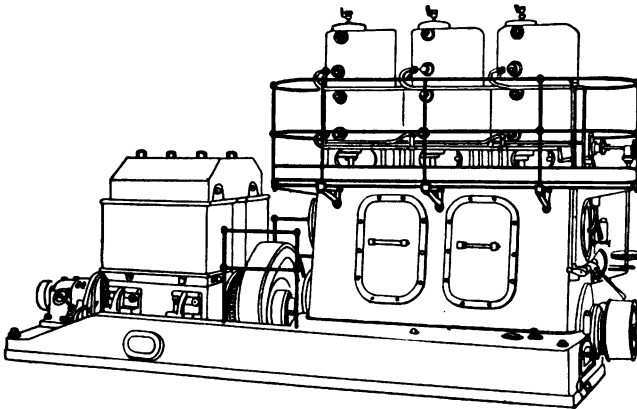


FIG. 11.

given by the balls to every spoke of the fly-wheel, completely wrecking the latter and doing serious other damage to life and property. In another case the proprietor of a factory had his brains dashed out, when entering his own engine-room in the dark, by the balls of the governor, the path of which encroached a little on the passage round the engine, and was not shielded there as it should have been. The author has found a hemispherical wire-netting cup as in Fig. 17 useful for this

purpose and sometimes for appearance' sake a similar burnished sheet brass or sparrd metal shield is used. The bevel and other pinions which operate the governor require protection at the intaking side wherever they are within reach, and that, it has been decided by the Courts, even where this part of the engine occupies a place inside a fence already erected for other purposes of safety. (*Johnson v. Richardson*, Q. B. D., 4th June, 1896.)

Metal or other caps should be fitted over all shaft ends which project into passages. In this way all danger from

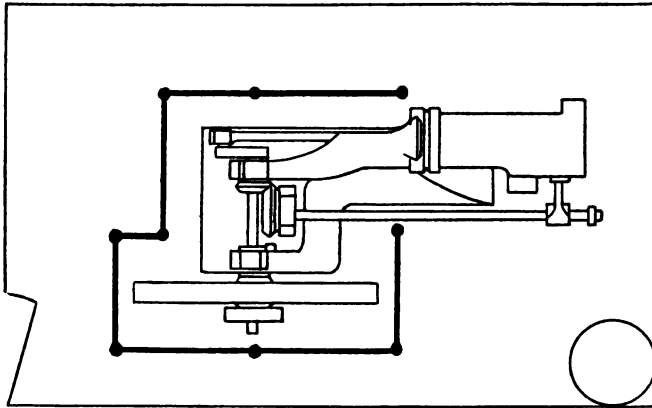


FIG. 12.

the catching of clothing on such parts and on the key heads and key ways on the same is avoided (Fig. 7). Crosshead ends and slide blocks should be effectively screened by sheet-metal covers hinged for access, Figs. 7 and 9, if not railed as in Fig. 8.

Blows from naked piston and other rods prolonged through the end covers of cylinders are very dangerous and sometimes fatal. These parts should be encased either in a light metal tube supported from the stuffing-

box gland (Fig. 8), or a similarly fixed but heavier cast tube with a pillar stay at the outer end. In large horizontal engines the weight of the piston is partly borne by such ends fitted with blocks and slides, and in Fig. 7 a neat and serviceable dust-proof shield is shown which is provided with inspection doors; in the case of large engines, well housed, rail fencing of the type and situation already described is generally used for the same purpose. A prolonged piston rod with air-pump connec-

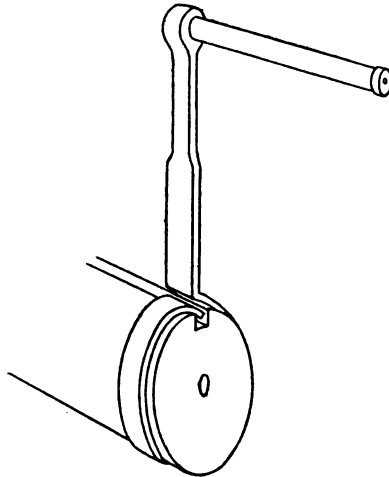


FIG. 13.

tion is shown fenced in Fig. 18. Main belting and ropes, if not entirely within the general fencing, should be screened underneath wherever they do not permit of a clear seven-foot headway.

Some valve and pump toothed gears found on engines also require fencing, particularly at the *intaking* sides of engaging pinions, while both above and underneath large beam and other engines, all shafts and other moving

parts over or under or alongside which any person may have to pass on occasion should be covered with tube, box, or other secure protection from contact. The narrow margin of safety which exists in some cases where powerful fly-wheels are subject to great fluctuations of load, and have broken up under the influence of centrifugal force and bending stress at unsuitable arm and rim connections, should lead to greater care in design, as the result of fracture is invariably serious. In many mill engines strong iron hoods are fitted, particularly in the case of heavy spur gear used as a fly-wheel, to restrain to some extent accidentally fractured portions of the rim

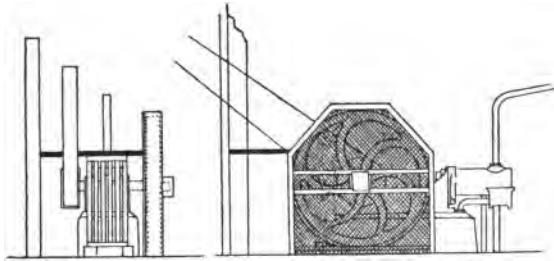


FIG. 14.

and prevent the splashing of oil and grease over the whole motor and house floor. Similar metal splash shields are common at engine cranks and serve to partly protect the same. A great part of the safeguarding of engine details can be most effectively performed by the makers, while, as we have seen, attention to the disposition of the parts from the point of view of safety will obviate the necessity for some of the protection otherwise compulsory under the statute.

The keeping of oils, waste, spanners, and other engine stores and appliances in lockers or on shelves *within* an

area fenced in accordance with the statute should be entirely prohibited. No attendant will, or would be expected to stop the engine before crossing the fence for access to such places, and the practice has directly led to serious accidents. A prime mover in motion at which the protection has to be crossed is not "securely fenced" within the meaning of the statute. The practice referred

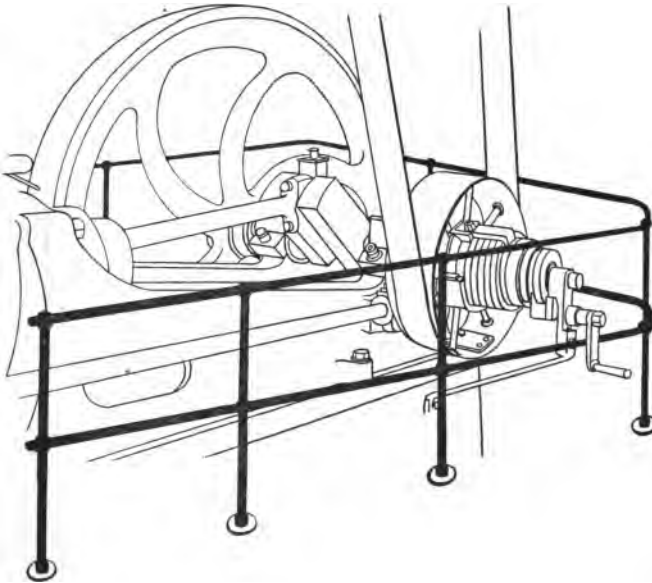


FIG. 15.

to is most frequently met with in small oil and gas engine-rooms.

Electric Motors, Generators, and Transformers.—These call for particular notice owing to the special risks involved in their use and management. So far as motors are concerned they are, when directly applied to machine

tools, usually fitted by the makers with a substantial metal casing which envelops both motor and gearing, leaving only the commutator, brushes, and terminals exposed; even these are frequently capped to exclude dust and protect from rough usage, and such protection should, when absent, be furnished by the users. Where belt connections are made with motors, the former run usually at a very high speed, and it is well to fence off the whole apparatus either by close boxing or by retired rail fencing, both for safety and to prevent damage to the plant. Generators have already been touched upon in connection with Engine protection (Figs. 8, 10, and 11).

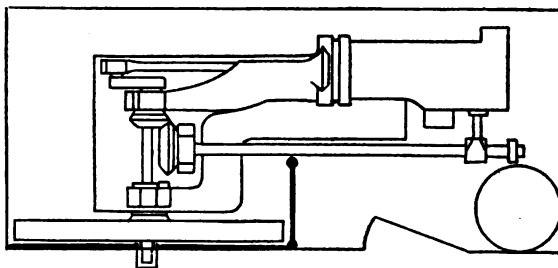


FIG. 16.

The introduction of large units and of direct driving in the generation of electricity has greatly simplified the matter of safeguarding the driving parts, which, ten years ago, and in the older installations now in use, caused fatal and serious accidents about unprotected rope and belt drives under, over, and around which attendants had frequently to pass. Rail fencing with cross passages in which overhead and low drives are securely screened will meet all the requirements of the latter class of machinery.

The special risk from electric shock in connection with the generation and distribution of electricity in factories, workshops, and other premises is one which has increased

with the progress in the use of high pressure. A dangerous and possibly fatal shock may be sustained by contact between two portions of the human body or even clothing, and two conductors differing in pressure by 700 to 1200 volts, according to the perfection of the contact. An insulated person safely touching highly charged metal and at the same time passing any conductor to another

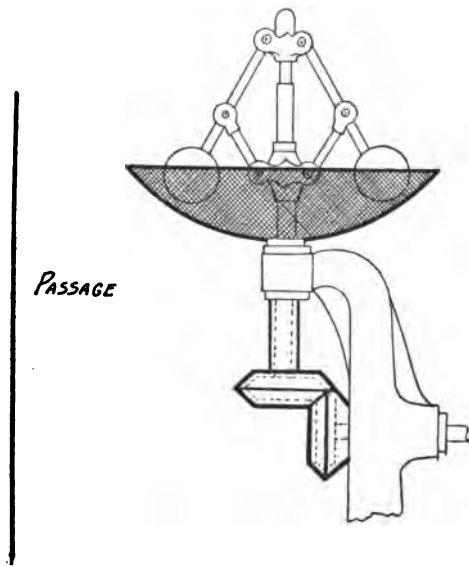


FIG. 17.

uninsulated person, or even touching the latter or an earthed conductor, may cause a fatal or severe shock. The metal of the dynamos, the switchboard and connections, the high pressure mains, transformers, and series arc lamps, is material from the touching of which under the above conditions dangerous shock would result. The ordinary fencing may be relied upon for protecting moving

parts of electrical generating machinery in the case of direct currents below a voltage of 700 and of alternate currents less than 350 volts pressure. All installations with higher voltages should be regarded as high pressure, and the following extra precautions should be adopted in view of the risk from shock. Generating machine frames and bed plates and transformer cases, ladders, and other metallic parts should be jointly and efficiently earthed, and the rail fencing about the former should be made of a non-conducting material, such as wood, while the

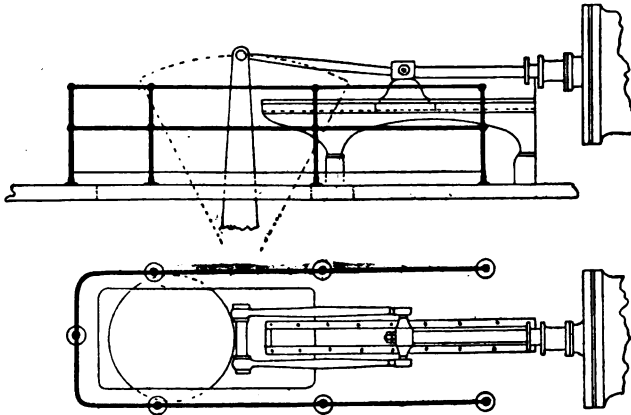


FIG. 18.

terminals, brushes, connectors, and other parts of high-pressure dynamos, motors, and other machines and transformers should be so arranged or boxed that no person with his body, clothing, or conducting tool can accidentally establish connection between two parts with a high potential difference. This requirement is assisted by the provision of oil cans of non-conducting material, and the use of insulated wipers and cleaners and of india-rubber mats or other material kept in a dry and efficient

state for an attendant to stand upon at such places on the floor where it would be possible for accidental dangerous connection with highly charged metal to be made.

There is really no necessity for the exposure in *front* of switchboards of highly charged metal parts, but where this is done, efficient insulation should be provided. At the *back* of such boards fatal shock has resulted owing to accidental contact, resulting in some cases from the exceedingly limited space there for moving about in executing repairs and making examinations. In such employments only skilled operatives should work, portable insulated covers should protect all highly charged conductors, freedom of movement should be obtained by enlarging the width of the space to at least four feet, and no extensive repairs should be attempted on high pressure conductors when alive. In the handling of high pressure mains and cables indiarubber gloves should be used on both hands and provided by the employer. Aerial cables in Factories and Workshops should be insulated all over or so supported that there is no possibility of contact with employees, and in this connection the clear headway necessary for the occasional movement of boilers, bridge, and other high structures in factories and factory yards should be kept in view.

It should be possible to cut out any arc lamp in a series when under repair, and transformer switches should be operated as far as possible outside the chamber, and the mains sufficiently insulated from the cases through which they pass. The chambers themselves frequently attain a dangerously high temperature, and ample provision should be made for the circulation of the external atmosphere.

The work of repairing or examining or temporarily

cutting off connection with all the high-pressure apparatus referred to should in every case be conducted under skilled electrical supervision. The subject of treatment in the case of apparent death from electric shock is specially referred to in Chapter XIV. on First Aid to the Injured.

Water-wheels, Turbines, and Windmills.—At the commencement of factory legislation the site of most of the textile mills first brought under regulation was determined, above all other considerations, by the position of a suitable water power, and the water-wheel safeguarding required by law has remained very much the same throughout the intervening years. Like the other prime

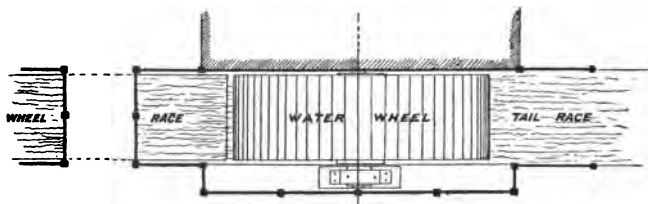


FIG. 19.

movers every part of a water-wheel or turbine must be securely fenced, and the wheel-race, unless otherwise covered in, requires to be fenced *close to its edge*. This latter provision prevents the use of the space, which would otherwise exist between any form of protection and the wheel race, and which has led to drowning and wheel accidents particularly amongst young persons and children. Fig. 19 represents the application of the statutory requirements, in the form of stout rail fencing of the double type, and which may be cross sparred, with advantage, to the breast water-wheel found in the ordinary corn mill.

When the wheel is in a house the same protection

must be afforded, and any exposed mill-gearing in either case must be fenced as described in the next chapter.

For access to the outside journal a passage over the wheel race is sometimes necessary, and the rails should be kept well clear of the wheel rim, arms and boss.

A number of water-wheel accidents occur in the winter months when the footing at external bearings, at no time the best, is very insecure and slippery, and when no protection is provided for safe access.

The most dangerous parts of turbines are the bevel wheel gearing, the top of the motion shaft, and the platforms or plank ways over pits and pentroughs. The former should be entirely boxed round in all cases, due provision being made for the necessary openings for lubricating purposes, and the latter, being nearly always in a wet and slippery condition, should be protected at both sides; while the race, if not otherwise protected, should be railed as above. The comparatively recent application of natural water power on a large scale to manufacturing purposes on the Continent, in the United States, and in Scotland, has led to the adoption of direct driving of electrical generators by turbines, no part of the latter being exposed and all gearing being dispensed with. The shielding of the fly-wheel generator moving in a horizontal plane and the guarding of the platforms are the chief requirements, and for the horse power generated—700 to 5000 for each prime mover—this is, so far, the climax of simplicity combined with safety of arrangement. Fig. 20 shows the arrangement of the multi-polar direct current dynamos at Foyers Aluminium Factory. Each armature, 8 feet in diameter, acts as a fly-wheel and is mounted upon the shafting of a 700 H.P. Turbine, 10 feet in diameter, which runs at 140 revolutions per minute under a head of 350 feet of water.

The windmill as a factory prime mover is no longer found in Scotland, is in use in one or two cases in Ireland, and is still found to some extent in England and Wales, particularly in East Anglia, where the configuration of the country renders the water courses of little use for

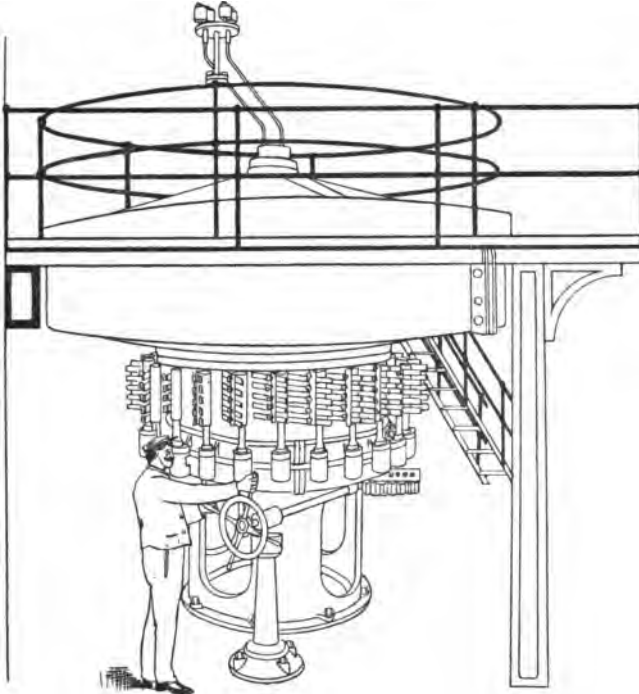


FIG. 20.

motor purposes. In addition to the safeguarding required about the closely set machinery in such mills and hereafter detailed, the special portion of the windmills requiring protection is the toothed gearing and shafting in the movable head of the tower. This can be efficiently

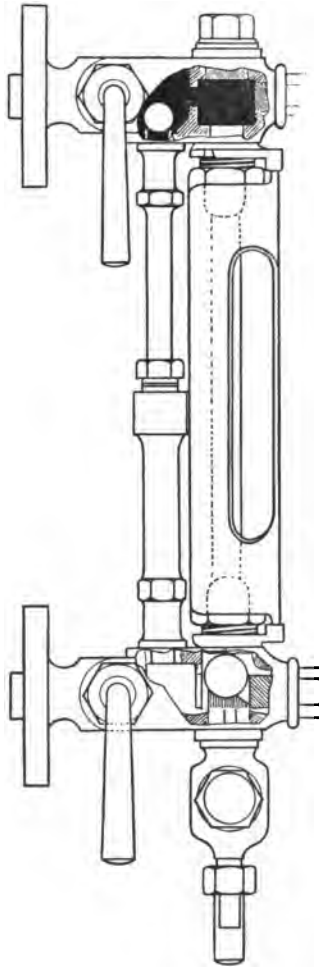
fenced with a little trouble by sheet metal hoods and tubing which move with the revolving head.

Steam Generators.—In connection with prime mover safeguarding several points of danger about steam generators require notice. Organised boiler inspection in connection with nearly all factories is very general and efficient, and the legislature has wisely left this to be done by private enterprise. Even under this system the rashness, ignorance and carelessness of the employer and workman is demonstrated from time to time as the cause of explosion and serious injury and damage, but the number of such accidents is few compared with the total generators in use.

A class of small factories however is to be found, chiefly in agricultural and remote districts, in which a second-hand boiler—history not necessary—is apparently a *sine qua non*. Every Inspector of Factories could tell some curious tales about such apparatus, their owner's ignorance, confidence, and in some instances marvellous immunity from accident. The safety valve weight has, as a rule, long departed from the lever in such plant, and a miscellaneous assortment of scrap iron takes its place. Fortunately the requirements of these Factories seldom demand a working pressure such as the scantlings of the boiler, if in good condition, would justify, but intermittent use and careless treatment result in undetected deterioration through absence of inspection, and consequent danger. Some legislative regulation of steam generators *not* insured is without doubt called for in addition to the existing powers, which are only operative *after* accident.

The separate prime movers, low shafting and toothed gearing found in confined spaces above boilers with economisers, mechanical stokers, and other auxiliary plant are sometimes overlooked in the matter of protection, have

caused serious accident, and should receive the same



secure fencing as similar parts throughout the factory. The bursting of gauge glasses is the chief external source of injury. This may be provided against in two ways. Fig. 21 represents Hopkinson's arrangement whereby on the failure of a glass the issuing steam and water are automatically cut off by the unbalanced pressure from the steam and water spaces actuating the ball valves, while an outer shield deflects the tube fragments. Wallach Brothers' two arrangements, Figs. 22 and 23, are confined to guiding the fragments of glass and the escaping currents of steam and water in a vertical direction, thereby preventing any injury to a person in front of the damaged glass, and permitting safe approach for turning off the gauge cocks. This object is secured by surrounding the front and sides of the gauge glass,

with a V-shaped or semi-circular piece of thick toughened glass in the centre of

which wire netting has been embedded in the process of casting. The thick glass, even should it crack under the high temperature and pressure of the impinging water

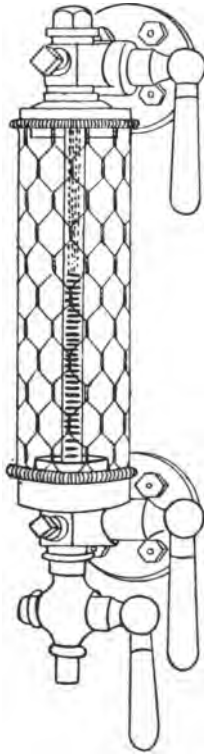


FIG. 22.

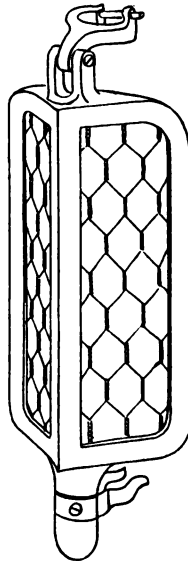


FIG. 23.

and steam, does not fall to pieces, owing to the binding action of the netting, and deflects the dangerous current away from the attendant.

CHAPTER VIII.

SAFEGUARDING OF MILL-GEARING.

THE term "mill-gearing," as we have seen in Part I., embraces every shaft, drum, pulley, toothed or other wheel used in conveying the main power from the prime mover of a factory to the manufacturing machinery. The number of persons who may meet with accident in the power house is naturally limited, but the "mill-gearing" of a factory may be necessarily or unnecessarily approached by a much larger number of persons, and the statute requires it to either "be securely fenced or be in such position or of such construction as to be equally safe to every person employed or working in the factory as it would be if it were securely fenced". The fulfilment of these requirements will be considered in detail, according to the position of the parts involved.

Elevated Mill-gearing.—In practice if no portion of any part of the mill-gearing is within seven feet of the floor level and if approach to it while in motion is *never*, except for necessary adjustment and lubrication, required of any person employed or working in a factory, it is considered to be in a position which renders it as safe as if it were securely fenced. At the same time the approach for the purposes mentioned is conditioned by the maintenance of fencing at all mill-gearing parts, except those actually under examination from which the fencing would necessarily be temporarily removed. The conditions of work in some factories, such as automatic lubrication, stoppage

in case of heated bearings and for replenishing oil cups or adjustment of belts and other parts, and the observance of these, make it unnecessary to specially protect elevated mill-gearing.

A great many factory industries, however, are so conducted that stoppage of the prime mover for approach to the elevated mill-gearing is seldom or never entertained, and the safeguarding law in such cases strictly applies. The same observations also apply to any single worker or class of workers whose duties naturally bring them to

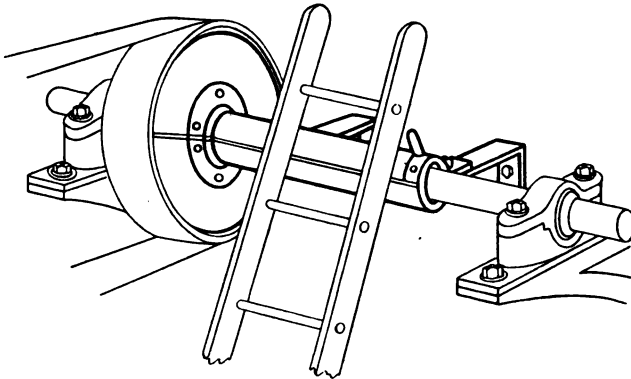


FIG. 24.

standing levels above the floor and within seven feet of mill-gearing parts.

The safeguarding of high mill-gearing may be of the close or of the platform type. Fig. 24 shews a method of securely protecting a worker from contact with shafts, wheel rims or spokes during necessary approach to the same in motion. The particular combination illustrated of metal tubes, discs and wall supports is manufactured by Messrs. Wallach Brothers, of London. In Fig. 25 is shewn the use of inverted U- or V-shaped sheet-metal

shields for 15 ins. on each side of mill-gearing journals requiring to be attended to when in motion, while similar protections of metal or wood may be used for lengths of shafting, being either supported from the wall as in Fig. 24, or hung from the ceiling or beams when the mill-gearing is so supported.

In many factories where high-speed mill-gearing, operating a large number of belts, is used, it is the custom to erect a permanent platform of the type shewn in Fig. 26. It may be entirely of wood or metal, and carried on brackets attached to a wall or columns, or, as in the illustration, may consist of a wooden footway and

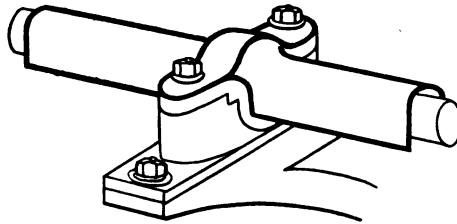


FIG. 25.

side fenders suspended by metal straps from the ceiling and provided with metal handrails. Such platforms are continuous when the belt-drives permit or are made in sections approached by ladders or stairs. The rail nearest the moving parts is kept well clear of the wheels or pulleys, and a workman by this means is enabled to perform various necessary operations about moving machinery in safety. Whether close or platform protection is adopted the intaking sides of all toothed wheels should be securely fenced by a close-fitting sheet-metal guard, which is an envelope of the wheel. In the case of bevel wheels a metal box is frequently substituted.

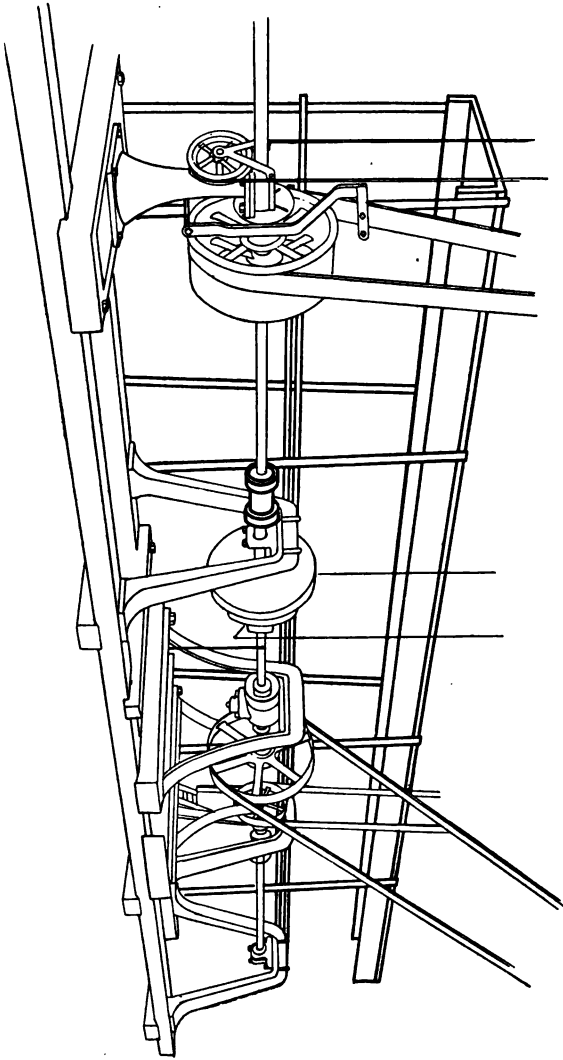


FIG. 26.

Low Overhead Mill-gearing.—When the parts of the transmitting machinery under consideration are less than seven feet from the ground or floor they become dangerous, in addition, to all the workers passing under them and must be securely fenced in *every* case. In such circumstances considerations of space generally necessitate close fencing, and in Fig. 27 an example of low set fenced gearing crossing a factory doorway and blocking the headway is given.

Either sheet metal or wood may be used to form a V-

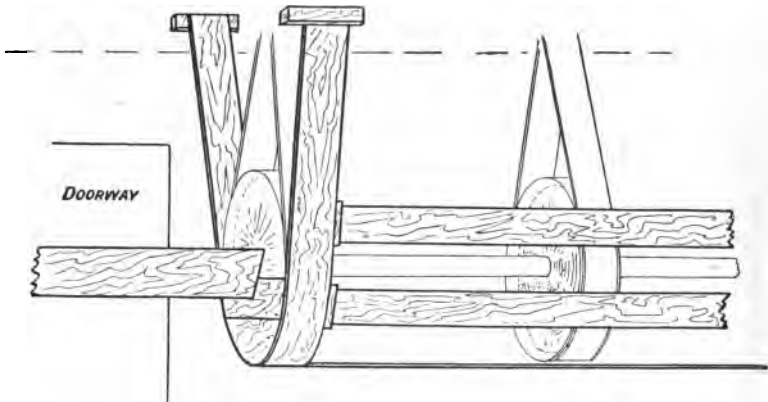


FIG. 27.

or U-shaped trough underneath the shaft, while the other portions of the latter and the belt pulleys carried by them are protected by parallel spars running between two semicircular guards underneath the extreme pulleys. The latter guards are easily supported by straps from the roof, and if they are hinged at one end (Fig. 28), and one strap be replaced by a chain or hooked rod, they can be let down in a moment for examination or belt repairs. Toothed gearing where occurring in such low mill-gearing

should be fenced as already described, while a specially large low pulley or wheel can be shielded by enlarging the fencing where it occurs.

The utilisation for factory work of low ceiled premises which were never intended to house machinery, leads to the crowding of plant and a great deal of consequent fencing, which suitable premises and better mechanical arrangements would render unnecessary.

Mill-gearing at floor level.—Various classes of factory

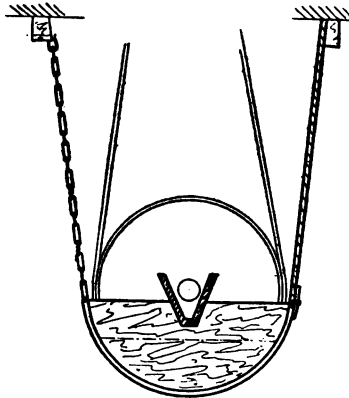


FIG. 28.

work and arrangements of power transmission require some of the mill-gearing to be placed on or near the floor. This is especially the case in grinding work of all kinds, in the sawing, dressing, and turning of bone, ivory, and wood, and many other similar operations. Fig. 29 shows a form of wooden rail fencing as applied to mill-gearing shafts and pulleys under a work bench. Two stout horizontal rails leave sufficient space under the lower one for brushing out the floor space enclosed, and room over the top rail for reaching to journals. Hinged flaps

of solid construction protect the worker's clothing from contact with each belt or pulley, and, while naturally falling into position, give ready access, for examination or repair, to the parts fenced by them. The provision of hinged flaps between the lower rail and the floor will also prevent the rolling of material or tools under the bench and the danger involved in reaching for the same, while access for sweeping is still possible.

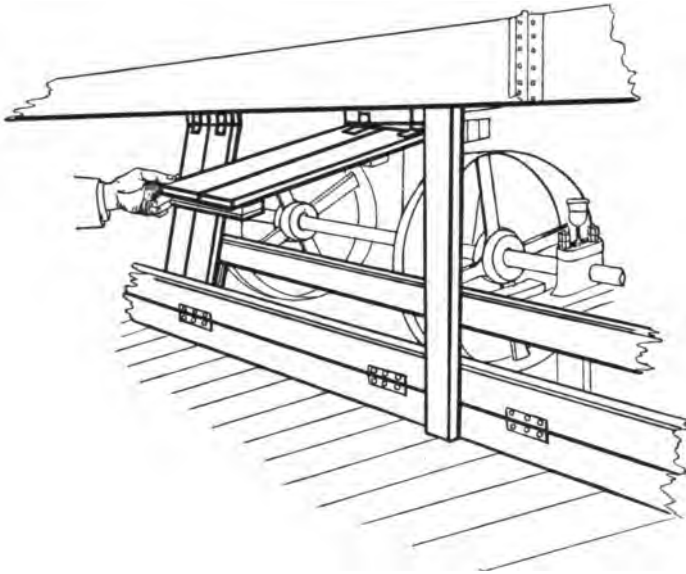


FIG. 29.

Where the transmitting parts are near the floor level and not under the cover of work or machine benches, the double rail and fender fence (Fig. 30) may be adopted in many cases where space is plentiful. In other instances close fencing of the type shewn in Fig. 31 is necessary and can readily be constructed in the form of box stools

of wood dropped into position and secured there by latching to the floor, or by a framework an inch or two in height nailed to the latter.

Vertical shafts passing through floors or rising therefrom must be securely fenced up to the height of seven feet and this can be most neatly attained, with freedom of access, by a square box of that length, embracing the shaft, and, with one side hinged and secured by lock or screws, standing upon a slightly wider base and kept in position by a framing or some form of fastening as shown in Fig. 32.

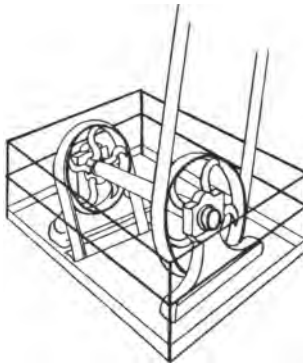


FIG. 30.

Mill-gearing underground.—Where a prime mover actuates a main shaft not more than five feet beneath the ground level of a factory, it is usual to make the portion of the factory flooring immediately over the mill-gearing pit portable and about three or four feet wide. No examination of shafting and other parts so protected should take place when in motion.

When the depth below the floor is necessarily greater, a room is formed beneath in which the rail, box, stool,

and other close fencing already described must be fitted according to circumstances and the position of the parts. This particularly applies to sawmill gearing pits, where double rail fencing and fenders may be used to protect the line shafting, pulleys, and belts, and cross rails and stools or trough guards for necessary passages over or under the shafting and belting, as the height of the latter may determine. Various special open and close safeguards of wood, wire netting, and sheet metal, made to telescope, slide, or roll up like a flexible shutter, are in use for the protection of underground mill-gearing, and

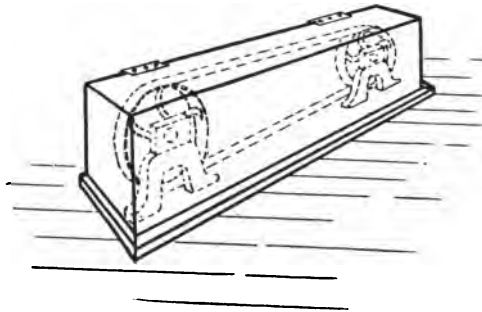


FIG. 31.

are applied under the same conditions as the fencing already described. Light shafting on the floor conveying power to a series of sewing or other small machines can be readily protected by retired wood or metal rails or close boxing or wire netting covering.

Prime mover safeguarding must be kept in position whenever the motor is running, and the fencing of mill-gearing parts in motion or use must also be constantly maintained in an efficient state, but the *removal* of the latter, *not* their entire absence, be it noted, is exceptionally permitted by the statute at such parts as "are under

repair or under examination in connection with repair, or are necessarily exposed for the purpose of cleaning or lubricating, or for altering the gearing or arrangement of the parts”.

As a matter of fact the practice of the most careful employers is to interfere as little as possible with mill-gearing in motion for the specified purposes, by providing for automatic lubrication and for examination or alteration when at rest. The fencing also should be constructed so as to necessitate as little interference

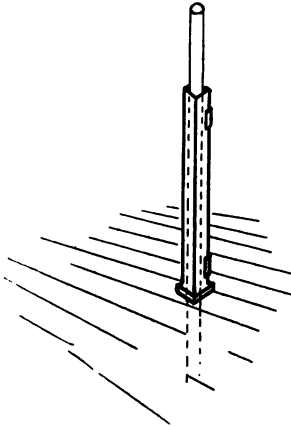


FIG. 32.

with it under the above conditions as possible. It should also be borne in mind that, though penal consequences do not attach to accident in the circumstances just detailed, the Workmen's Compensation Act applies, and other civil remedies of the worker *may* apply according to the circumstances.

Mill-gearing details.—The danger from slight frictional contact of clothing with mill-gearing shafting is one

which is pretty generally recognised, and is sadly demonstrated by a long fatal and serious accident roll, though here and there an employer or works manager may be met who exhibits practical scepticism on the subject by ignoring the statutory safeguarding regulations.

Such conduct is folly of a criminal character. If anything is *proved* in the course of factory inspection it is that *no* liberties can safely be taken with main shafting by any person, however experienced. The degree of lap or adhesion required to cause accident does of course vary with the roughness or smoothness and relative speed of the shaft, but the legislature has wisely made the fencing rule an inclusive one in this respect.

With regard to mill-gearing, as was the case with prime movers, while the main protection must generally be fitted after the parts are in place, much can be done beforehand by the makers with respect to the safe design of various details. In addition to shafting, the couplings and collars thereon are the most fruitful sources of accident owing to the manufacture of these with unnecessarily projecting bolt, pin, and key heads, which readily catch upon a ragged sleeve and quickly increase their hold upon the person.

In Fig. 33 the ordinary flange coupling of this description is shewn with its array of clothes-catching nuts and bolt heads, while alongside are the thickened flange coupling and recessed bolt, and the rim flange coupling beyond which these fastenings do not project.

On the shafting in Fig. 26 also, an example of the split sleeve coupling with collars shrunk on is shewn, while in various couplings of irregular shape and special design provision is made for neat and safe sheet steel or tinplate covering.

The result of all these and other manufacturing pro-

visions of like nature, which add but a trifle to the original cost and have only to be specified for by the purchaser. is that a smooth cylindrical surface is obtained, much safer in the event of accidental contact. Key-heads also where necessarily projecting can be easily capped.

Collars with projecting pin heads are not seldom found on each side of a journal when used to prevent end motion of a shaft. In necessarily approaching such

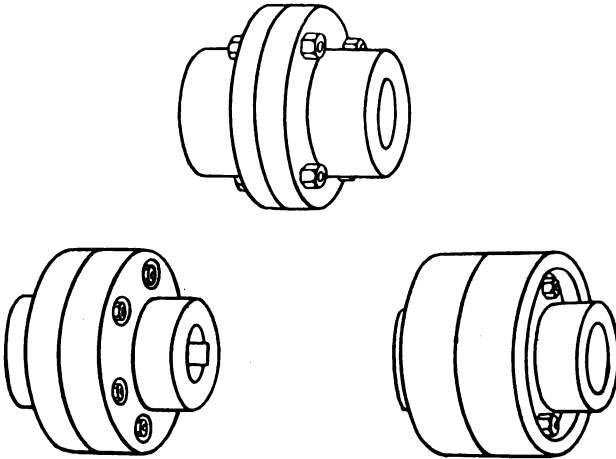


FIG. 33.

a bearing, particularly in dark situations, an attendant has been frequently caught, wound round the shaft and maimed for life, or, in cases where the shafting is close to the ceiling, has been dashed to pieces by repeated blows on the latter.

Tinplate caps supported from the pedestals, or, what is better, the metal shielding for 15 ins. on each side of a journal, shewn in Fig. 25, would effectively prevent such

calamities, while in *every* situation the projecting pin collar need not be used at all, the remedy being in the hands of the purchaser and maker at a trifling outlay.

Fig. 34 shews the ordinary collar, which in its larger sizes has sometimes several projecting pins, and the same collar of slightly greater diameter with smooth surface and recessed pin heads.

A very useful smooth collar is that shewn in Fig. 35, and made by Messrs. Trier Brothers of London, where the halves of a split collar are drawn together and separated by rotating the cheese-shaped body of a pin with right- and left-handed screws. A smooth surface

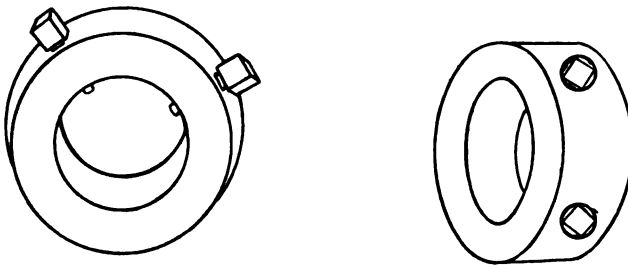


FIG. 34.

is presented and the collar has the advantage of being fitted and removed in a few minutes without unshipping the shaft and the various parts keyed to it.

Mill-gearing control.—The control of main shafting from any part of a factory in case of accident is necessary in large or scattered premises, as the speedy overhauling of the moving parts may obviate serious injury and even save the life of a person caught in the machinery. This desirable end can be obtained either by contrivances applied to sections of the transmitting machinery or by apparatus directly controlling the steam engine or other prime mover used.

Of the former, the fast and loose pulley arrangement with accompanying belt shifter is the simplest. It is usually fitted at the driving end of the main line of shafting of a flat, and may be operated by a cord from any portion of the room length. For tenement and small factories it is found quite suitable and is also a source of saving by reducing the frictional resistances when the

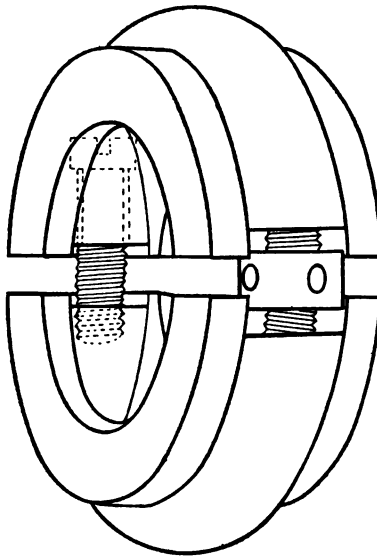


FIG. 35.

length of shafting controlled by it is not required. One of the pulleys may be dispensed with by using Lindsay's friction driven disc pulley (Fig. 36), a very useful contrivance for a small power.

Where, however, the primary transmitting gear consists wholly of shafting and toothed gearing, or, as in many of our modern mills of the best type, the shafting

at each level is directly driven by ropes or straps from the engine fly-wheel, clutches of various kinds may be introduced to control the various sections.

The well-known three-pronged clutch can always take the place of fast and loose pulleys in small installations where the speed is moderate, but the risk of fracture from shock, and consequent break down, is too great in factories of any size, and various forms of friction clutch may take its place. The latter contrivances have been

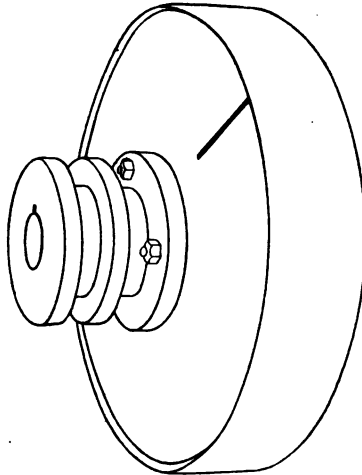


FIG. 36.

greatly improved within the last decade, and there is no valid reason now why a *new* factory should not have adequate and reliable provision for controlling the mill-gearing of each flat, by means of a friction clutch there applied.

Fig. 37 is the Bagshaw-Addyman clutch in which by a rapid screw action the wedge A and levers BB expand the friction ring C on the same shaft till it firmly grips

the hollow drum of nearly the same diameter on the other shaft. The application of the same clutch to a toothed wheel or pulley is also shown (Fig. 38), and either shaft may be the driver.

Some other forms of clutch, particularly those of the cone shape, require considerable pressure to keep them in action, with resulting undesirable end thrust, and while many excellent contrivances of the kind exist, their efficiency is in most cases confined to a limited range of power transmission.

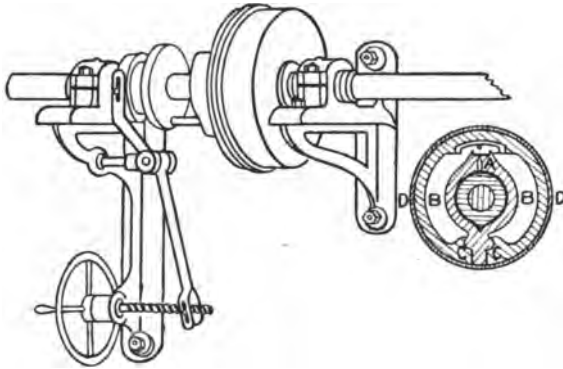


FIG. 37.

Fig. 39 is the Lindsay coil clutch adapted for instantaneous disengagement from any part of the section controlled by the pulling of a cord. The clutch is on entirely novel lines, the principle taken advantage of being the enormous gain in gripping power obtained by the friction of several turns or coils of a rope or other fastening on a cylindrical body. A steel helix of gradually reducing section is coiled round a specially hard sleeve on the driven shaft and fits easily on the same (Fig. 40). The large end of the helix is attached to the

driving shaft, while the small and free end is twisted so as to come into frictional contact with a plate or cone which can be pushed against it by sliding along the driven shaft. Whenever such contact is established the helix immediately coils itself round the sleeve with an irresistible grip and begins to drive the shaft. In Fig. 39 it will be seen that the cone is kept in action by reason of the pressure of a lever, and a pull on the cord from any part acting at a considerable leverage disengages the cone from the helix attached to the driven shaft, and the coil friction and the power to drive cease at once.

The coil clutch has the largest range and application

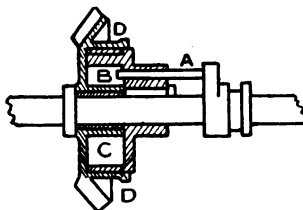


FIG. 38.

of any, being constructed to transmit from a few horse-power up to 10,000. Its usefulness when fitted in duplicate in rolling and other mills with non-reversing engines is obvious.

The provision of the above sectional controls for mill-gearing is very satisfactory, for the opportunity of minimising the danger to life and limb where an accident occurs is immediately and completely in the hands of those who witness the casualty.

Where, however, such provision is an afterthought, as is the case in most of the older factories and in not a few of the newer ones, the necessary interference for

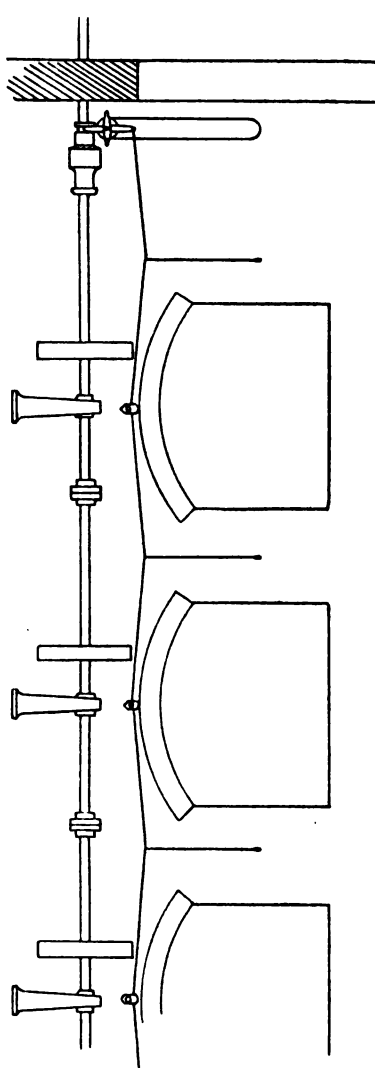


FIG. 39.

this purpose with the established mill-gearing is not often entertained, though it is really of a slight character, and the prime mover of the works is resorted to for control purposes.

The most primitive arrangement of this nature is the

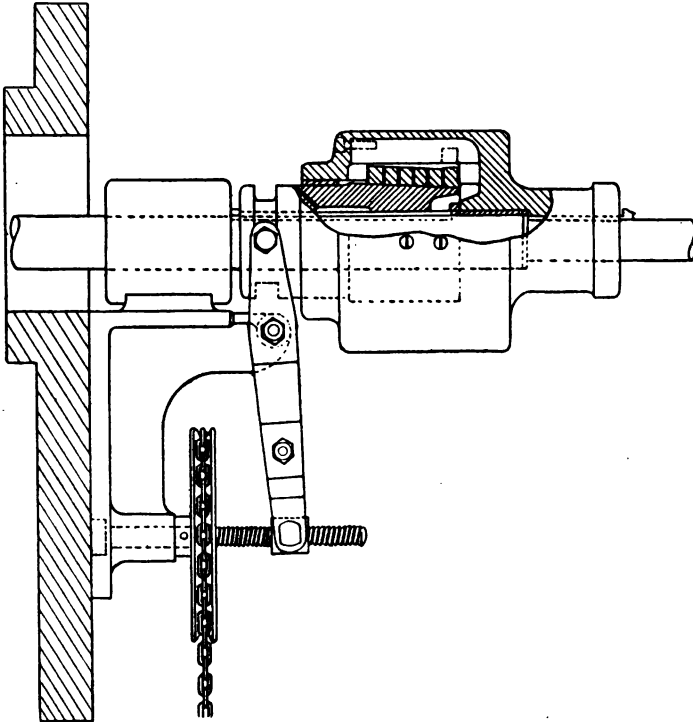


FIG. 40.

mechanical bell-pull alarm, often superseded now by an electric bell-push, on each flat. Each of these arrangements, however, depends for its efficiency upon the constant presence of an attendant in the power house where

the bell is rung, and experience has proved this to be unreliable. To get over the difficulty automatic stop motions have been invented. The principle of all these, however, is the same. A piece, capable of conversion into an electro-magnet by a current from primary batteries controllable by pushes at various places on each flat, is introduced at some actuating part of the prime mover. In the steam engine the gears of the throttle valve, the governor, the slide valve, the expansion or cut off valve, have all been used for this purpose, and various special valve gears, such as the Corliss and Pröell, lend themselves to such arrangements for throwing out of gear.

In Fig. 41 Tate's electrically actuated stop-motion is shewn applied to an engine stop valve. The latter when opening coils up a strong spiral spring under the hand wheel, the release of which can be brought about by a trigger operated by an electric impulse given from pushes at any part of a mill. When this is done the stop valve is rapidly closed under the action of the unwinding spring, the vacuum in condensing compound engines is automatically destroyed, and the prime mover and mill-gearing stopped in consequence.

The same control may be separately and automatically operated from governor or other special gear in case of engine racing.

Electrical controls being seldom in use are apt to get out of order when not regularly supervised, but the necessary impulse may be wholly mechanical, in which case a wire, terminating in a knob at a central part of each flat, is enclosed in a tube and led by means of bell cranks to the power house. The connections are very carefully fitted, so that no "play" exists in the apparatus. When applied to the Pröell valve gear, the pulling of the knob at any part of the factory, acting simultaneously

at the steam engine, disengages the trip gear, causing the double beat valves to drop instantaneously upon their seats, and completely cuts off the steam supply. An air valve may be opened by the same movement to

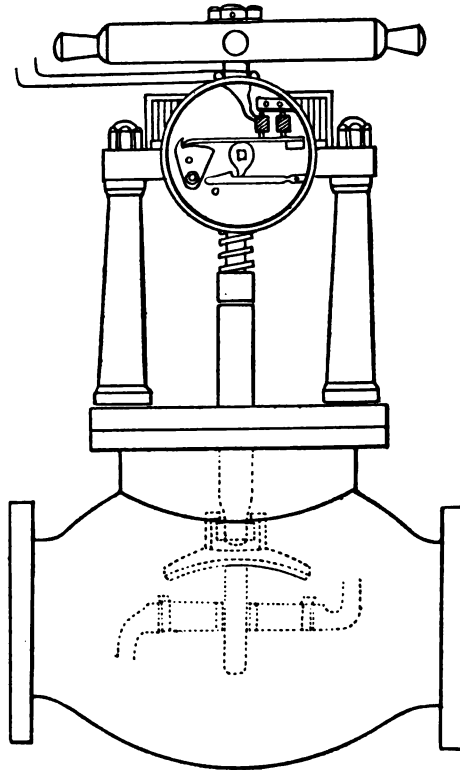
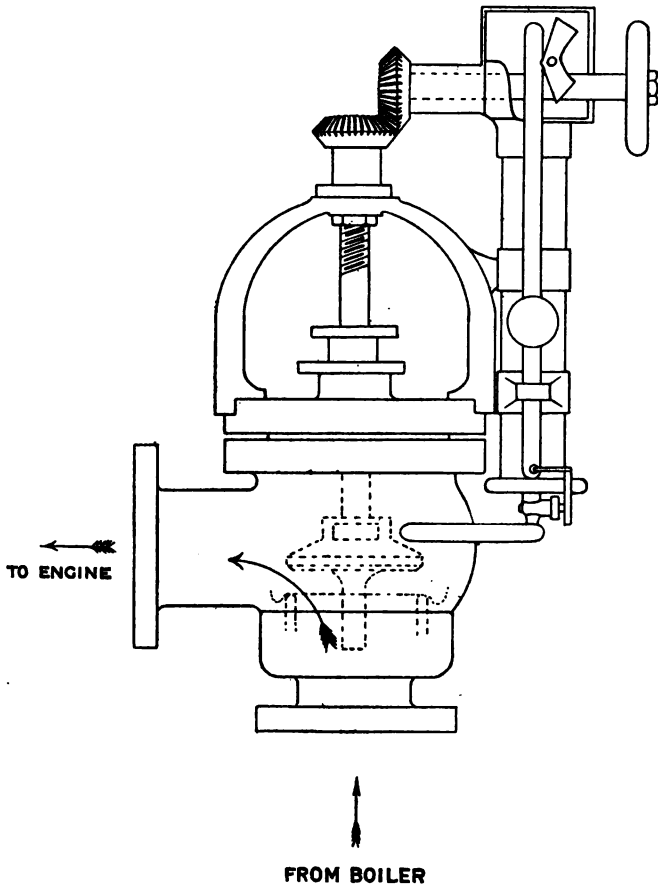


FIG. 41.

destroy the vacuum in the low pressure cylinder of a condensing engine.

Fig. 42 is an elevation of a stop motion in which the

impulse, either electrical or mechanical, causes a weight to fall, and thereby admits steam from above the stop



FROM BOILER

FIG. 42.

valve to a small auxiliary cylinder, the rack piston-rod of which in rising operates a pinion, shaft, and pair of

bevel pinions, and closes the valve. The steam is thus shut off simultaneously from the engine and the stop motion.

Unsatisfactory electrical impulses can be made positive in their action, and thereby safer, when the push is arranged to control the stop motion by *withdrawing* the current from the mechanism. In that case, should the current—intended to be constant—fail, the fact is at once announced by the simultaneous stoppage of the prime mover, and the batteries can be readjusted accordingly.

The devices described can all be adapted for also signalling from the engine-room to the various flats on a prearranged system, and thereby indicating to persons about machinery the intention of the attendant to stop or start the prime mover. This precaution is a useful one when repairs or cleaning are intended to proceed at machinery when the motion ceases, or when the same are in progress at idle machinery.

CHAPTER IX.

SAFEGUARDING OF HOISTS AND LIFTING TACKLE.

AMONGST the parts required by the statute to be securely fenced in all circumstances are every hoist or teagle, and the safeguarding of cranes and other lifting tackle may be conveniently grouped in this chapter with the subject of hoist protection.

The importance of safeguarding the latter class of machinery may be gauged from the fact that, in factories during 1897, 36 lives were lost and 381 injuries received by hoist accident.

No generally applicable rule can be laid down for the protection of such apparatus, for the conditions under which it is used determine in each case whether it is "securely fenced". In considering these conditions in detail, this useful but dangerous auxiliary to the factory may be considered under several forms, namely, Passenger Lifts, Goods Hoists, and Bag and Bale Hoists.

Passenger Lifts.—In this class of hoist the cage should invariably be roofed over and its sides other than the exit one should also be cased in. This prevents any injury from falling material, and to the feet of passengers when inadvertently placed beyond the cage floor and caught by projecting obstacles in the sides of the hoist well. In Fig. 43 an example of a badly protected hoist is given. The single low unshipping rail is of no use as a protection and is the cause of many accidents, such as a passenger waiting for the hoist and looking down the

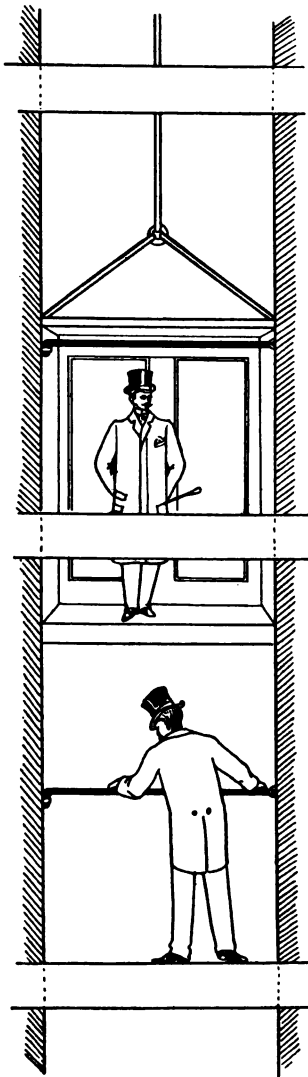


FIG. 43.

well being caught between the rail and the floor of the silently descending cage, with resulting decapitation. Again in the absence of a sufficiently high safety door passengers on the cage, while unconsciously projecting the head beyond it on ascending, have been severely injured between the floor of the cage and the top of the doorway. Falls down the well through absence of any protection or a failure to close doors or replace bars are common. Persons have also been precipitated to the well bottom owing to the removal without warning of the cage to another floor when they expected it to be at their level. Again many hoists can only be operated by reaching over the protection—if any—to the starting ropes and where these are missed, or gripped and broken, serious falls result. Hoists in Factories are rarely constructed for passenger use alone. So far as safety doors are concerned a passenger factory hoist is only

safe under two conditions of working. Where the traffic is fairly constant a man may be employed whose sole duty it is to travel constantly on the cage, answer all signals, and open on arriving and shut on leaving at each level the safety doors or gates, which should only be accessible from the cage, should not be less than six ft. in height, may be solid or sparred to admit light, and may slide, telescope, or swing. The absolute character of this protection is obviously dependent upon the diligence of the caretaker.

Alternatively the gates should be perfectly automatic, in which case they should fulfil the following conditions: they should unlock or open on the arrival and stoppage of the cage and should close when the latter ascends or descends from their level. It should not be possible to open them from the outside and they should not open when the cage is merely passing a floor without stopping there.

Fig. 44 is Etchell's Safety Doors which, among others, meet those requirements. The doors when the cage is absent are kept closed by strong springs. The locking gear is shewn in Figs. 45 and 46. When passing any floor without stopping, the locking gear is withdrawn and immediately replaced, the doors remaining closed. The latter when unlocked on the stoppage of the cage are pushed open by the attendant and held open by automatic spring catches, which release and relock the doors immediately the cage begins to move. In arrangements where the safety door is *not* unlocked for a brief moment, when the cage passes a level without stopping, it is necessary for the attendant to set an index finger or other contrivance whereby only the doors at the level at which the cage is first to stop will be automatically raised or opened on arriving, and shut or lowered on leaving.

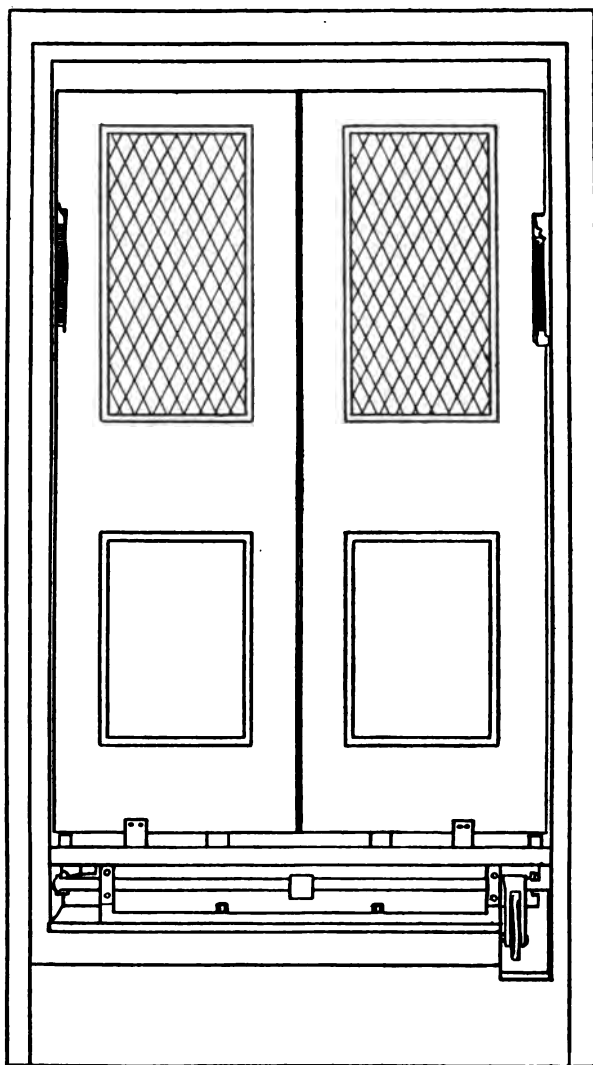


FIG. 44.

Goods Hoists.—Many hoists are used indiscriminately for passengers and goods. In such cases automatic protection should be afforded where the doors are not operated from the cage side by an attendant. As a rule the goods hoist has a much larger opening at each level than a cage used only for passengers, and it is possible to ship or telescope the safety gates upward, leaving the floor space around the hoist entry free of all obstacles to the manipulation of material.

Fig. 47 is an example of such an automatic Goods

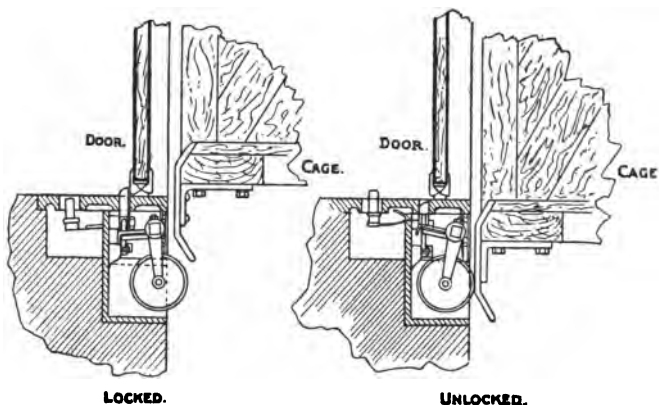


FIG. 45.

FIG. 46.

Hoist door made by Mr. Worrall, of Liverpool, where open steel gatework is used, which may be telescoped in rising for spaces where the headroom is insufficient. In this arrangement only the gate at the intermediate level for which the numbered index finger is set opens and closes automatically on the arrival and departure of the cage, while the protections at the top and bottom floors are always opened by the cage when at these levels by means of fixed projections operating keys at the gates.

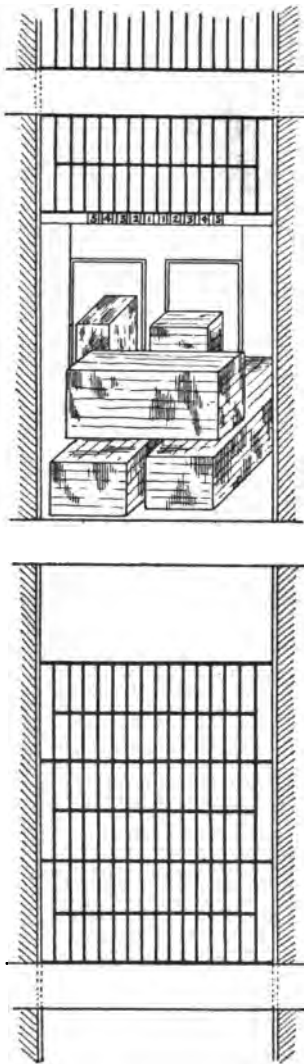


FIG. 47.

The latter can be made of wood or other material, but iron or steel is found to be the most durable.

In the well-known freight hoists of Messrs. A. & P. Steven, of Glasgow, the prevention of any one from gaining access to the hoist well during the absence of the cage is attained in a different manner (Fig. 48). The cage on arrival unlocks each partly counterbalanced safety door, which, in the absence of the former, is held down by the engaging of the catch C with a notch N in the guide post. On coming to any floor the cage side presses in the lever end of catch C and, releasing the latter, enables the gate to be raised by an attendant either outside or inside the hoist. By means of the connecting rod R and two links the movement of the lower catch C is communicated to an upper catch U, and the latter entering a corresponding notch in the guide post keeps the gate up after being raised. Whenever

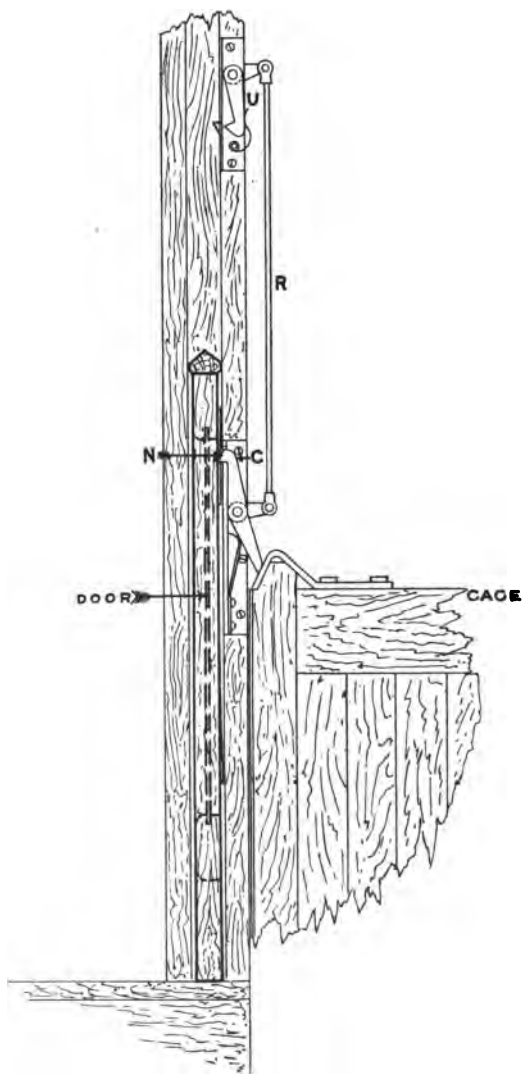


FIG. 48.

the cage leaves the level the catch U automatically releases the gate, which drops, while C simultaneously returns to the locking position. The gates on Messrs. Steven's hoists are constructed with stout wooden frames filled in with wire netting, and are high enough to prevent any one looking over the same.

There are several other forms of safety door gear for hoists, but they are nearly all on one or other of the above principles—*i.e.*, the gates are either simply unlocked at each level, raised by hand if the cage stops and lowered automatically when it leaves, or for particular gates on the levels at which the cage is to stop on its journey there are previously set index fingers or other arrangement whereby the doors are automatically unlocked and raised, and afterwards dropped and relocked.

In some warehouses and storage premises in factories where the traffic is intermittent, hand lifted and swinging gates are used for hoist-well protection, but the risk always remains of forgetfulness on the part of the user leading to serious accident to himself or another. So prominent was this cause of hoist fatality and injury that the Act of 1878, which only required the secure fencing of hoists or teagles "near to which any person is liable to pass or to be employed," was amended in 1891 to the extent of leaving out this proviso and the protection must now be absolute.

Bag and Bale Hoists.—These are of two kinds, namely, those inside and those outside the factory. The internal bag hoist takes several forms. A common one, especially in grain and other mills, is a square opening in the floor at each level, which is closed by two heavy flap doors, Fig. 49. These doors open under the pressure of the rising bag, or bale of necessarily limited dimensions, but do not attain a vertical position and fall back immediately

the bag or the load is cleared. In this class of hoist care should be taken to bush the chain holes in the flap doors with metal, owing to the rapid wear of the wood and the increasingly large opening formed thereby ; also it is well to have a small stop on the flap hinges, which prevents the doors from being folded back upon the floor, leaving a dangerous opening with possible serious accident from a fall.

Where bulkier loads are dealt with a much larger permanent square opening is made in each floor and railed round, as in Fig. 50, with stout wood or metal

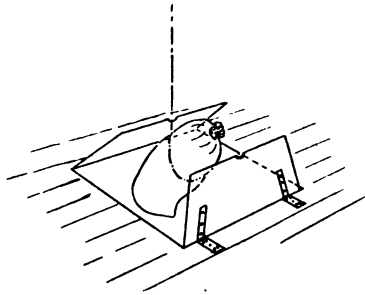


FIG. 49.

posts and bars. At one or several sides in the case of grain and feeding stuff goods a shelf is provided on which the bag or bale is deposited, unslung, and carried on the back to its place. When heavier goods are dealt with in an open lift of this description the bars on one side have to be unshipped while the hoisting to any level is proceeding and replaced immediately upon its conclusion. Many bag hoists of this character exist, and they depend for their safety, in relation to other persons as well as himself, upon the carefulness of the attendant in replacing the fencing.

Where the hoisting is external to the factory a teagle is used in which a cantilever beam above the top storey of the lift (Fig. 51) carries the pulley block, and the goods are taken in at the various floors through openings, barred when not in use by doors and portable rails. The dangers of this operation are obvious. The attendant may have to reach out to grasp a surging load and fall through losing his balance, or being drawn off the door ledge by the oscillating chain. Such reaching operations about all classes of unprotected lifts are sometimes partly safeguarded from serious fall by providing the workman with a radius belt, which is long enough to permit of the

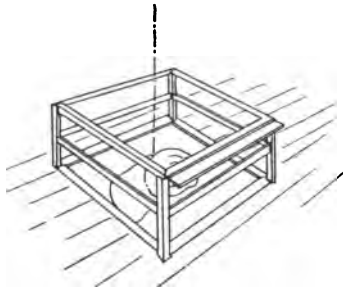


FIG. 50.

requisite movement in connection with the slinging and unslinging of loads, and sufficiently strong to suspend him in safety in case of fall until help is obtained. Such a precaution, however, can only apply where one man has his duty entirely within the circumscribed area and does all the hoist handling at his level.

Hinged platforms, held when in use in the horizontal position by stout rods or chains (Fig. 51), are sometimes fitted, and in other cases such platforms are provided with handrails and flap doors which cannot be folded back (Fig. 49), as already described, when the goods to

be dealt with are sacks, bales, or casks of dimensions suitable for such handling. Signalling and directing is rendered safer by this means.

Steam and hydraulic cranes with a horizontal arm at each level are also used in some cases in which heavier loads, after being raised to the desired level, can by a separate movement of the machinery be carried by a trolley along the length of the arm and detached from the sling inside the factory or warehouse. In such cases there is less occasion for the attendant to look over the

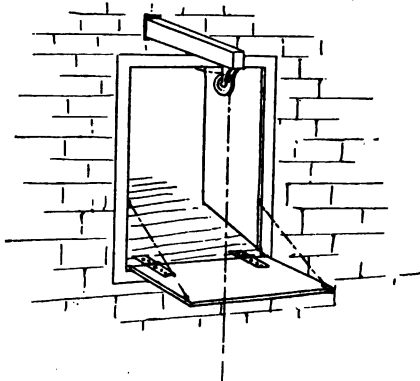


FIG. 51.

floor ledge, but, owing to the necessity for signalling, danger from that cause is not entirely removed.

Where external hoisting by means of teagles, or the other tackle referred to, is carried on in connection with storage premises, such as Dock, Railway, and Bonded Warehouses, portable double rails should invariably be provided, in addition to the doors, if the latter are not made in upper and lower divisions; for in these places ventilation and lighting frequently necessitate the keeping of teagle doors open when hoisting is not proceeding.

Hoist Details.—In the safeguarding of hoists attention requires to be paid to several minor points. Serious and fatal accidents from the stretching and breaking of the suspension ropes and the precipitation of the cage and its freight to the bottom of the well are not unknown. In the most carefully designed and constructed hoists two wire ropes, which are not likely to break simultaneously, are used, each of which will alone safely carry about six times the maximum working load, and resist thereby all shock and exceptional stress. The wire ropes used for such purposes sometimes rapidly deteriorate through the fracture of the outer strands if the pulleys over which they are bent are of too small a diameter. Periodical examination should be made of the cage suspension gear.

In view of the serious results attending sudden detachment of the cage various safety gears have been invented for arresting the fall of the latter in such circumstances. In some cases a cam, ordinarily kept out of action by the tension on the ropes, is brought into play, and forces toothed sectors to bite and grip the guide posts, thereby suspending the cage. Fig. 52 shows the method successfully adopted by Messrs. A. & P. Steven on their hoists. In the usual course of work the ropes A and B share the cage and freight load. Should either of them yield, the horizontal lever C carrying the weight W is raised or lowered, — according to which rope stretches or breaks, — throwing out the cam-shaped lever L by means of the pin P. The shaft S which crosses the cage top is thereby rotated, and the knives K which it carries on each end are at once forced into the wooden guide posts G, thereby securing the cage in any portion of its travel. In the event of a simultaneous fracture of both ropes the weight W causes the lever C to drop with the same effect as before.

Hydraulic hoists may fail in the above way, and when valves and packing are out of order they develop "creeping," *i.e.*, very slow movement from the level at which they have been stopped. This also sometimes occurs with ordinary hoists, but the provision of automatic

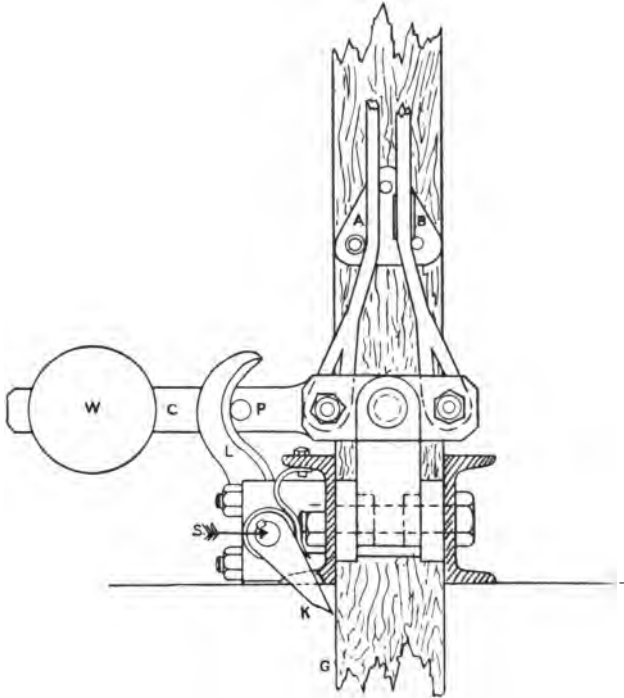


FIG. 52.

gates always ensures the protection of the hoist levels after the unexpected removal of a cage by defective gear.

In Sack and Bale hoists operated by the pulling of a rope from any level it is important for safety that the

lifting should cease without a special approach to the starting ropes for the purpose.

Many accidents have happened through overwinding, where a man has started such a hoist and then proceeded some distance to attend to other work.

Fig. 53 shows the application of the Lindsay disc clutch, already described, to a sack-hoist winch. The lever L, if lowered by a pull on a cord, causes the hoist to lift, and, if similarly raised, permits the load to run down

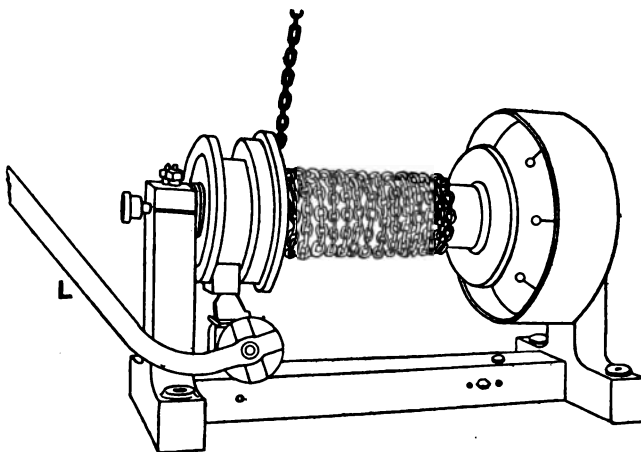


FIG. 53.

freely ; while the moment either cord is let go the brake acts and brings the chain to a standstill.

Cranes. — This class of machinery claimed a large number of victims in factories during 1897, no less than 59 persons being killed and 1317 injured.

The Steam Jib Crane is a combination of prime mover and mill-gearing which requires to be fenced under the same regulation as the larger combinations of a like kind discussed in the two previous chapters. Too often,

SAFEGUARDING OF HOISTS AND LIFTING TACKLE. 161

however, it escapes such attention from employers on the plea that it is "only a crane".

From the point of view of design, safety is not always sufficiently studied in crane construction. Reversing handles and bars are frequently arranged so that, when thrown over, a man's knuckles are just in the bight of powerful pinions, while the penalty of a hand or even an arm is exacted by such adjacent unfenced gearing should a single slip be made which precipitates the attendant upon it. Proximity to such parts can often be avoided by regard for safety when designing, and all the pinion and wheel intakes of first and second motion lifting gears, of the jib lowering, raising, and slewing gears, can easily be closely protected in the limited space in which they are packed by sheet metal casings or fenders. Owing to the reversible character of all such toothed gears *both* engaging sides should receive attention.

The overhead travelling crane, in some of its older forms, possesses very real dangers for the attendant. Not to speak of unfenced platforms or portions of such, with a sheer fall of 25 ft. to 30 ft. in some metal working factories, the travelling carriage simply bristles with reversible pinions requiring fencing. It was only recently that an unprotected crane of this type came under the author's notice, in which, 12 ft. above the highest illuminating source, and in the shadow cast by the latter, a workman had as a regular part of his duty to step over a nest of three powerful bevel wheels running unfenced on the crane platform level. A slight miscalculation in taking the familiar step in the dark caused a fold in his trousers to be gripped, and his leg was sacrificed in consequence.

In the newer cranes of this type the provision of a cab sometimes, particularly in electrically driven ones,

below the travelling beams, and with all operating levers at hand and the work to be lifted in full view, greatly reduces the risks, and the protection of exposed pinions and provision of safe access to the crane level almost wholly removes them. Owing to the severe injury which a small body dropped from an overhead crane can inflict upon a person below, *all* platforms and stagings of every description should be provided with fenders or skirtings to prevent the accidental rolling off of spanners or necessary tools in use.

Winches.—These handy prime movers, combined with various lifting tackles, are largely used about Vessels, Docks, Wharves, Quays, Warehouses, and Buildings under construction, in addition to their extensive factory applications, particularly in Ship, Boiler, and Bridge building works. Such machines should also have all the pinions and the engine parts which might cause accidental injury carefully close fenced or fended. Generally set on a low bed, or driving diagonally at the hand level, particular attention should be paid to the protection of engine parts on winches and other steam hauling plant which allow of little clearance between the bed plate or frame work, as numerous crushing injuries to fingers and toes have been caused thereby, with fatal results in some of them from tetanus.

The seemingly harmless *hand* winch as has been shown in Chapter VI. may, when highly geared and tackled, and allowed to run down loaded and unchecked to save a little time, prove a deadly machine through the stressing of the cranked handle by centrifugal action beyond its ultimate tenacity and the fatal blow of the flying metal.

Crane Details.—A considerable number of injuries at cranes occur in the manipulation of the loads. Care-

less slinging accounts for some, and not seldom it is another person in the hold of a vessel, or on the floor of a factory, who pays the penalty. Hoisting operations are frequently directed from the narrowest of platforms, sometimes merely a 12" or 15" plank, on which a loss of balance without any chance of recovery and a serious fall are almost certain to follow a blow from a surging load or an injudicious movement.

Where piecework discharging or shipping of cargoes is carried on, or where tackle is used by independent gangs in ship or bridge building, the workers themselves are not seldom the greatest offenders in this respect, often seeming to count every moment spent in testing tackle, or erecting it and platforms in a safe manner, as wasted. The failure of chains and slings from time to time under loads much smaller than would be expected is due partly to absence of examination, whereby damaged links would be revealed, and partly to molecular changes in the structure of the metal owing to often repeated stress, which periodical withdrawal from use and careful annealing would obviate.

Cranes should be carefully surveyed from time to time for the discovery of any necessary adjustments: quite recently the omission to replace a simple split pin at the top pin joint of a jib crane stay caused the latter to work loose and wrecked the whole plant and the house upon which it fell, while a few months ago the unnoticed dropping out of a similar pin, and working off of the pinion which it secured, caused the fall of a heavy crane jib and the death of a workman who was passing at the moment.

Cranes, shear legs, and hoisting tackle in the open yards of works, and at dock and quay sides can only have their safety insured by periodical skilled survey,

and the responsibility should be definitely assigned to the works millwright or other suitable person.

The rapid manipulation of material in iron and steel works, at docks, in sawmill yards and other factories, necessitates the hoisting of weights in places where unskilful slinging—and consequent fall of the load—is

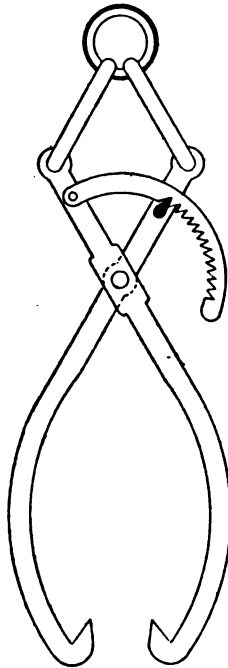


FIG. 54.

very likely to inflict injury upon persons beneath. To obviate this quite a number of specially constructed grips are used in place of the ordinary chain or rope sling. Fig. 54 represents a form of safety “dogs” or grips in which a notched sector engaging with a paul

on one of the legs affords some security against the unexpected release and fall of the load.

The occasional failure of hydraulic lifting gear, already referred to in connection with hoists, is particularly dangerous when this form of power is employed in the cranes of foundries and iron and steel works, for a sudden jerk to a foundry ladle or tilted steel works converter, full of molten metal, has inflicted serious and fatal injury. Safety gear for this purpose is used in the form of locking and brake arrangements on converter and ladle toothed wheels and axes, weighted bottoms causing a released vessel to return to the vertical position, and simple and spring-loaded non-return valves, which are ordinarily kept open under the water pressure, but fall upon their seats at once on the failure from any cause of the hydraulic main. Systematic inspection should invariably be made of hydraulic control valves and spindles, and the latter should be periodically renewed.

CHAPTER X.

SAFEGUARDING OF DANGEROUS DETAILS OF
MACHINERY.

WE have now to consider that large class of machine parts which is left after prime movers, mill-gearing, and hoists are disposed of, and which the statute has defined inclusively as "all dangerous parts of the machinery". These must be protected under the same conditions as "mill-gearing," *i.e.*, they must either be securely fenced or be in such position or of such construction as to be equally safe to every person employed or working in the factory as if they were securely fenced. We shall consider in the present chapter the common details of machines which are "dangerous," and the approved methods of safeguarding for such, while the succeeding chapter will be devoted to typical machines which in their parts and working are particularly "dangerous," and require special precautions and forms of safeguarding.

Toothed gearing.—Of the 289 persons killed and the 16,487 injured in factories during 1898 at machinery in motion by mechanical power, a considerable number, particularly of the non-fatal injuries, were caused by the unfenced toothed gearing on individual machines, which should always be regarded as dangerous. While some prime mover and mill-gearing parts have necessarily to be fenced by the user after they are in position, there is no reason why the driving and feed pinions of hundreds of different classes of machines should be sent

out by the makers in an unprotected and dangerous state.

A manufacturer of such can provide a more effective and much neater guard than the user, when he gives the subject the attention it deserves. In designing a machine also, as in the case of the prime movers and the other apparatus already referred to, the disposition of the parts from the point of view of safety is in the maker's hands, though the opportunity is often neglected, and, even when professedly arranged for safety, it is frequently done with the exhibition of very little intelligence. Amongst many examples of such the author recently found a whole series of dangerous bevel pinions on a large machine, made by a firm of note, to the top sides of which costly brass castings of excellent design were fitted, no regard being paid to the fact that the top-side in the working of the machine was the out-running one, and *not* dangerous, while the bottom *in-taking* and only dangerous portion was nearest the workpeople and wholly unprotected. These so-called "guards" are worse than useless.

Fig. 55 represents a portion of a wood moulding machine by a well-known firm, in which the above error is committed. The pinions P, P, being covered on the top by semi-circular hoods, and thereby inducing employees to regard them as harmless, while the really dangerous wheel and pinion intakes at W, W, are unprotected, and have gripped the clothing and limbs of workers.

The nests of pinions at the sides of sand papering and other wood-working machine tools, at paint, colour, and similar grinding rolls, at laundry pressing, folding, and ironing machines, and at large calico, letterpress printing, and paper machines are a few, amongst some

of the other cases, in which the maker's safeguarding is ill-considered, inadequate, and sometimes wholly useless.

In the wood-working machine illustrated, and in other types where shavings and chips of the material are abundant and apt to drop over the machine side, the top covers referred to prevent the clogging of the toothed gearing and possible breaking of the same, but

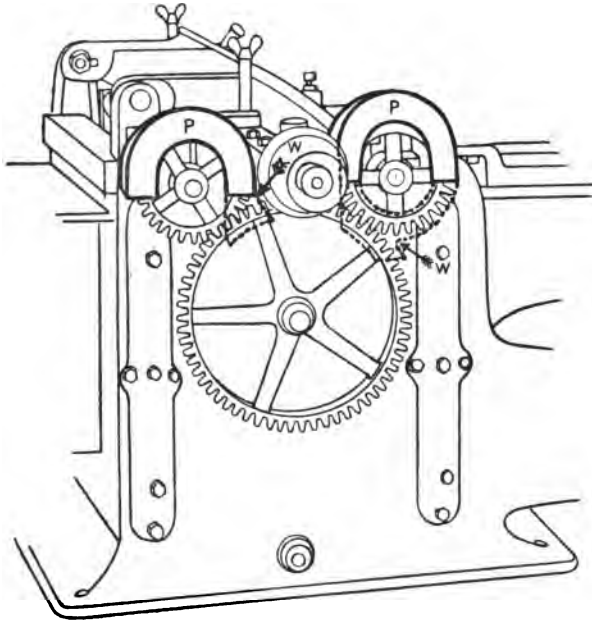


FIG. 55.

for safeguarding the workers, a function which is often claimed for them, they are of no service unless designed to embrace the intaking portions of the pinions in the manner indicated by the dotted lines on Fig. 55.

When the purchasers of machine tools of all kinds

specify for the effective covering of every dangerous part, and cease to be satisfied with what one occupier, on the occurrence of an expensive accident, said "looked like a guard," competing manufacturers will, as a body, comply with the demand, and that in a manner and at an outlay which will contrast very favourably with the fencing which is an afterthought, and sometimes most unsatisfactorily executed. Where, as is the case with nearly all our large railway companies and other corporations, and with many private firms, the subject of safeguarding machine details is taken up with earnestness and diligence, and in hearty co-operation with the Inspectors of the Factory Department, the results are in every way admirable, and accident from unprotected toothed gearing in such establishments is reduced to a minimum.

Safeguarding by the user, of some kind, can, in the long run, be compelled under the statute, but the author's experience is that, in the case of the multitude of occupiers of small factories with no mechanical facilities or aptitude, nothing can take the place of good fencing fitted by the makers, and all accident is thereby *prevented* by being anticipated.

Whether any legislative compulsion on the maker is desirable in this direction is doubtful. The supply in the author's opinion will respond to the demand, and in some directions is anticipating it. Engineers and appliance makers must have noticed the great extent to which the columns of British technical journals have been recently taken advantage of for advertisement by leading tool makers of the United States, but they may not have observed the careful regard paid to safety in the illustrated designs, and the excellent guards which are fitted at every dangerous part. Some home tool

makers leave little to be desired in the protected machines they offer to the public, and, in the textile machinery industries particularly, the safety of such plant has reached a high standpoint, and only requires minor improvements and the bringing of the protection of old machinery in mills up to the present standard. Some examples of well safeguarded machine toothed gears are now given, and, in all these, the users of unfenced machinery may attain the same results, but, as a rule,

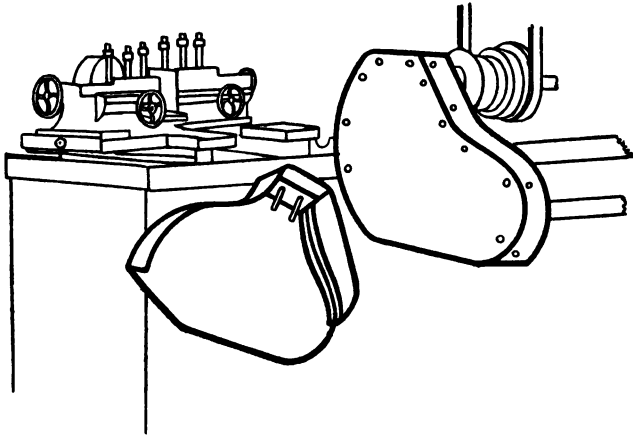


FIG. 56.

neither with the same economy, durability, and neatness as the maker of the tool.

Fig. 56 represents a sheet metal fence for the change wheels of lathes, which is hung by two pins from the bearing, and in passages sufficiently wide, may be hinged instead, with the advantage that it cannot be laid aside and is in the way unless when protecting the pinions. The author has met with some difficulty in getting this simple and cheap guard fitted owing to the alleged

absence of danger, but even a superficial scrutiny of the classified accident returns prepared by H.M. Inspectors brings out the fact of the insidious danger attaching to the intaking portions of such nests of slow moving toothed gearing.

Fig. 57 is a well-protected engineer's milling tool, in which the swivelling head is designed by the makers, Messrs. Greenwood & Batley, Limited, of Leeds, to act as a guard for the toothed gearing.

Fig. 58 is a radial drilling tool by the same firm, in which the bevel pinions operating the vertical spindle, and the spur gear on the driving shafts are securely and neatly fenced, while Fig. 59 is the universally distributed

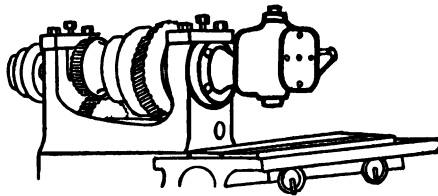


FIG. 57.

vertical drilling machine with the bevel wheels entirely enclosed in the manner adopted by these makers. Provision for lubrication is made at the hole P, from which a brass tube conducts and distributes the oil. Similar facilities for oiling are provided in the case of the other tools. Where, as in all lathes, and in the smaller and lower framed milling and drilling tools, the back speed and other driving and feed pinion intakes are brought within reach of the worker, or are running into the machine frame with very little clearance, neat sheet metal or V-shaped bar fencing can be readily applied, and that with due access for speed alteration. The smallest pulley on lathe and other headstock driving

cones should always have a deep side flange where adjacent to toothed gearing.

Fig. 60 is a sketch of well-protected bevel pinions on a wood-boring machine. In power drills of the vertical type, particularly in those for metal work, the later designs show a tendency to revert to a former practice in placing the driving bevel pinions at the extreme top

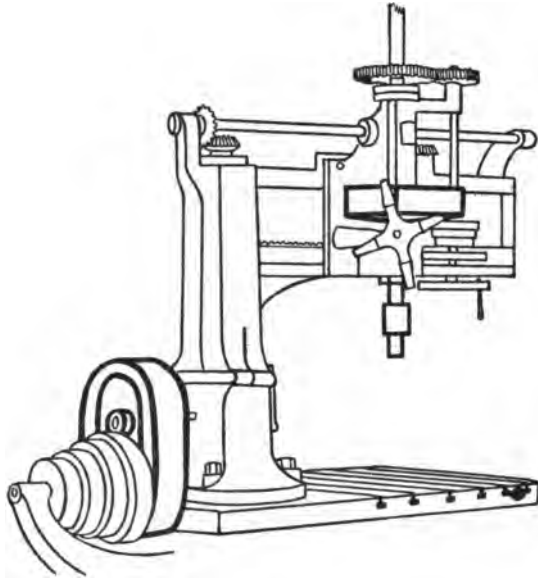


FIG. 58.

end of the spindle, a position which generally obviates fencing for this particular part of the tool.

Fig. 61 is another example of gear fencing, wherein the driving wheels of a horizontal boring machine are well protected by its makers, and in which the guard, as in the three previous instances, is an integral part of the design.

Milling, shaping, and special combination tools with all the driving gear low set are a growing feature in modern metal working factories, and Fig. 62 is an example of one such, in which the main spur wheel and pinion, the bevel wheel, and worn gear intakes are all protected by close fencing, both on the face of the teeth and at the sides of the same.

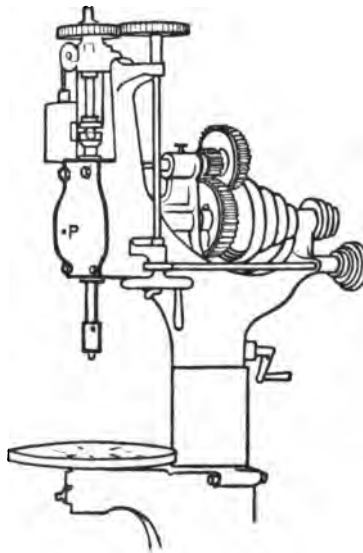


FIG. 59.

Other metal machine tools the toothed gearing of which, whether feed or driving, should be carefully guarded by the maker whenever possible, are those for shaping, slotting, slot drilling, vertical and horizontal planing, plate edge planing, punching, shearing, rolling, bending, screwing, tapping, and turning. In a number of cases it is found to be convenient to cover in by neat

circular, semi-circular, or segmental sheet metal or wood guards the entire portion of wheels in gear which are visible and accessible. This is advantageous for pre-

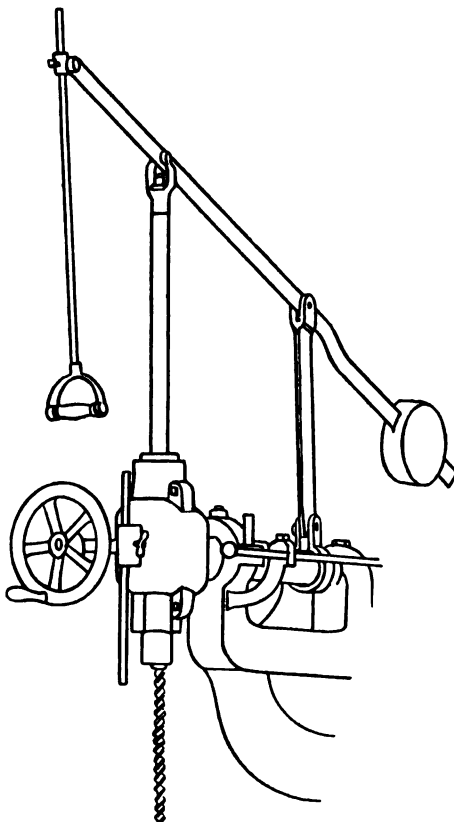


FIG. 60.

servation purposes, particularly in the case of boiler, bridge, and shipbuilding machine tools, which are necessarily situated in open places, and exposed to the weather

and rough usage. Where open rail fencing is adopted for special combination tools occupying a large space with their gear, such as boring and tapping machines for large work, no storage of tools or necessities should be permitted within the fencing, otherwise safe-guarding of the close type must be provided.

The author has dwelt more particularly in this division upon metal working tools, and for this there is adequate reason. No less than 44 per cent. of all the accidental

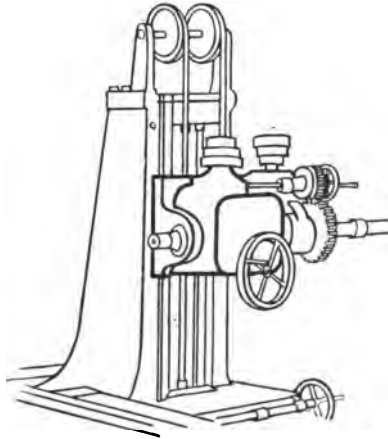


FIG. 61.

deaths in factory employments, and 42 per cent. of all the non-fatal injuries therein from machinery, take place at the mechanically driven tools used in the metal working trades, which embrace metal extraction and conversion, shipbuilding, engineering, tool and appliance making, and employ barely 27 per cent. of the total factory workers of the United Kingdom. These trades have a further exceptional roll of killed and wounded from other causes, some of which are hardly preventable; but the

precautions just advocated and described would, if given general effect to, go far, in the opinion of the author, to eliminate a large number of the former class of accidents. The above observations and directions upon the subject of protecting dangerous toothed gears apply equally to those found in driving or feeding wood working, printing, chemical, clothing, miscellaneous, and textile

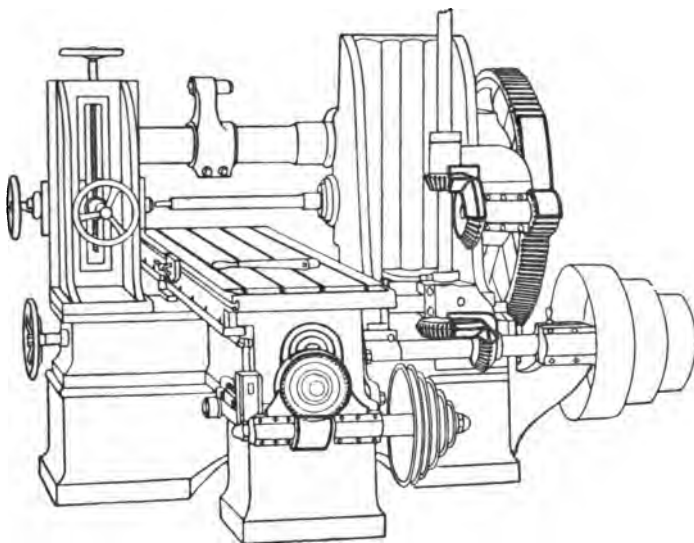


FIG. 62.

machinery, and in concluding this section several examples of pinion safe-guarding in the latter industry are given. In the jute and flax and other dusty textile operations, a very general preference is exhibited for open fencing, which protects and yet permits of observation. A good example of this is shown in Fig. 63, where the nest of pinions which stud the end of

a tow-carding machine is protected by a cage of open rod-work 6' 6" high running the length of the machine and locked or otherwise securely fastened during the working period. Fig. 64 shows the close, neat, and effective continuous cast-iron guards fitted to the side pinions of a cotton-carding machine. In this example it will be noticed that the small, overhung pinion P, a guard for which cannot be conveniently supported, has its dangerous intake fenced by mounting in front of it and on the same spindle a much larger disc of sheet

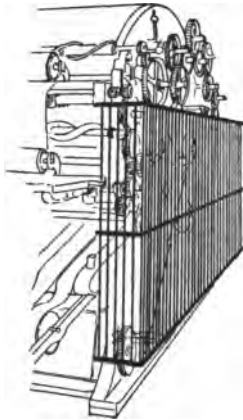


FIG. 63.

metal. This expedient can be resorted to with advantage in many classes of machine pinions where the multiplicity of moving parts prevents the fastening of a guard to the machine frame and the access required does not permit of cage or box protection supported from the floor.

The sectional and portable cast-iron guards used for the numerous and adjacent bevel pinions of a cotton-roving frame are shown in Fig. 65. In each of the two

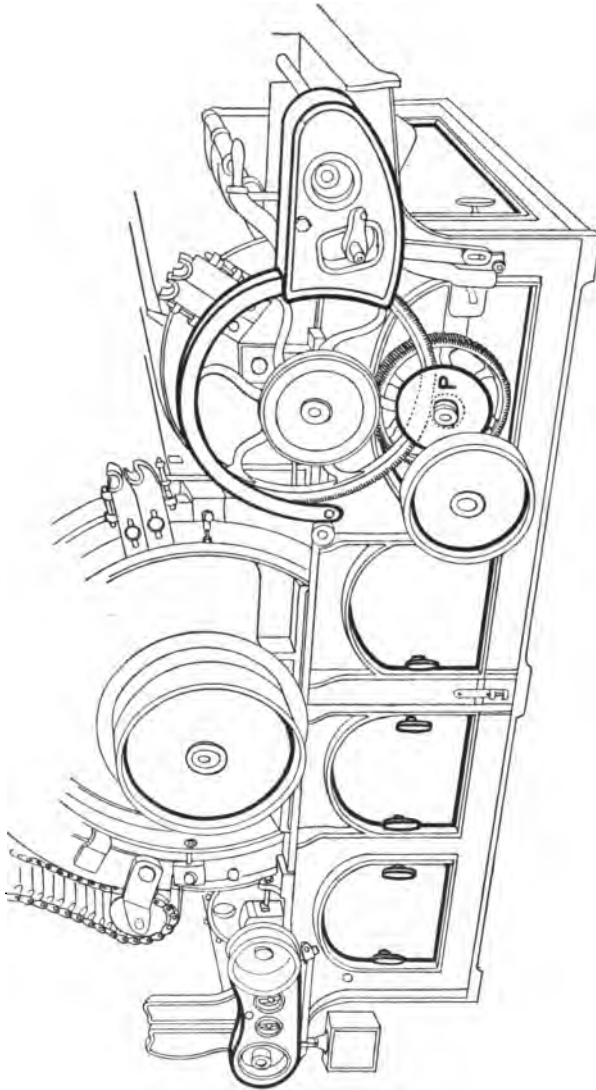


FIG. 64.

latter examples of textile protection the admirable fencing in the form of portable doors at all low parts of the framing to which access is required should be noted.

While the primary portions of toothed gearing requir-

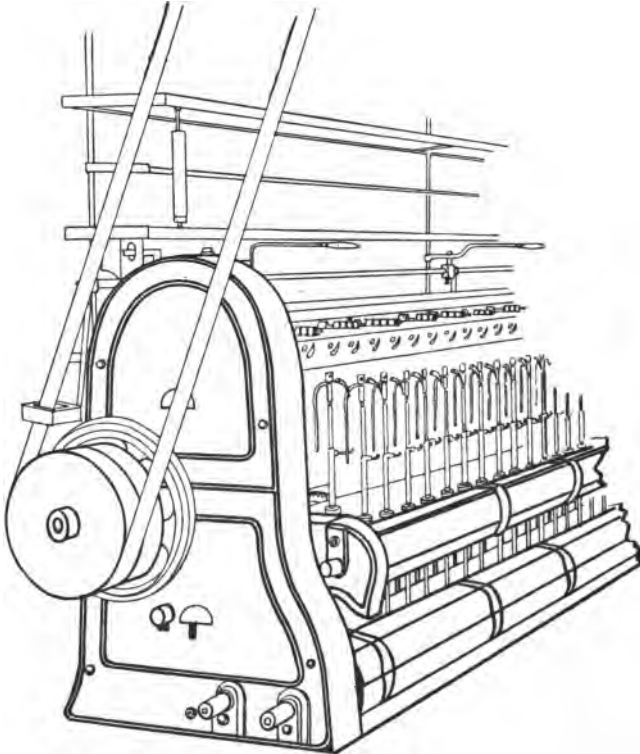


FIG. 65.

ing protection have been described and illustrated, there are circumstances in which more requires to be done to secure complete immunity from accident. Spur wheels which are running partly beneath a factory floor and are

protected at the intake, where that is exposed, without being hooded or boxed over, are very dangerous from the shearing action between the arms and the floor, when any tool, or a portion of a workman's limbs, is inadvertently pushed into the gaps. A low fender sometimes surrounds the wheels in such cases, but often that provision accentuates the nature of the probable accident. The fender should either be as high as the wheel rims, or the complete hood or box fence adopted. Where two toothed wheels are revolving on the same axis but with opposite or differential motions, as in some metal working, baking, and other machinery, the outside wheel should have a sheet metal disc pinned neatly to the inside of the rim, thereby covering the gaps between the arms from which Inspectors find accidents to arise.

Shafts and Spindles.—Any low motion shafts likely to cause injury by contact with clothing can easily be tubed in the classes of machinery just described, while the safety of such as must run exposed can be largely ensured by the same attention to the absence of projecting pins from thrust or distance collars, as has already been indicated in the case of the more powerful mill-gearing shafting. The absence of projecting pins in the best workmanship at all machine spindles will be noticed in the examples already given. This can be effected either by the use of taper feathers or wedges, such as cotters, which, when driven home, secure the drill or other tool in its socket without leaving any dangerous projection. Many serious accidents through being caught by spindle bosses such as *a* (Fig. 66) have occurred. When a wedge or other non-projecting fastening is not used, the spindle boss should be enlarged as at *b* and recessed to receive the head of the tool securing pin, which is tightened with the aid

of a box key (*c*). Collars of objectionable design already in use may be hooded when near a machine bearing, but, when on spindles, this is a clumsy method, and is soon disposed of by a workman, as it interferes with his operations. In the latter case the thickness of the original collar should be sufficiently increased by the shrinking upon it of a supplementary one, recessed as above to receive the pin head. The length of the pin fastening has too frequently no relation to the purpose it has to serve, and is greater than is required particularly in the case of cheap and badly finished and designed counter shafting and spindles. Here, as in much of the previous class of dangerous machine details, prevention of accident lies largely in the hands of the maker, who is always subject to the specification of the purchaser.

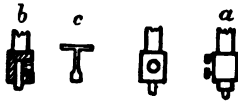


FIG. 66.

It is the practice of machine tool and appliance makers, particularly when building for stock, to leave considerable projections of shafting or spindles to permit of choice in the arrangement of driving by pulleys. These, sometimes with, and sometimes without, flats and key seats, are a source of serious accident, and when only partly required, or not at all, should in actual use be cut down to a minimum, cut off, or screened.

Belt and Pulley Gears.—The design, arrangement, and management of the driving straps and bands in a factory considerably affect the safety of these indispensable machine details.

The strength of a belt, whatever its position, is

obviously important if it is not to yield under its load and come violently whipping down upon persons and machinery. Even a good belt may so break when the joints are of inferior construction or workmanship.

These connections are of various kinds. A belt joint may be butted, overlapped, or spliced, and secured by cementing and lacing or riveting, or both. One joint of a belt is generally left uncemented, and is made in a form easily broken for tightening purposes. Besides the lace, many forms of patent screw and other fastenings are in use for the latter purpose, but, so far as the present discussion is concerned, it is not chiefly the necessity for strength and durability in these which has to be emphasised, but the power they have, when running low enough, to inflict injury upon the worker. The points of the screws used and the nuts are necessarily on the outside of the belt, and are frequently longer than is required. Not a few instances of severe lacerations upon the face and permanent disfigurement have come under the author's notice from the particularly long and ragged points of some forms of patent belt screws, while accident from the whipping of loose laces is a common experience. Diagonal or horizontal driving of most machines is necessary if sufficient frictional contact with the pulleys is to be secured, and the portions of belts below seven feet from the floor level, and with which any worker may come in contact, should be regarded as dangerous and fenced wherever practicable. For this purpose sufficiently high fenders of the box, wire netting, or rail types may be used when the floor space is not restricted. In the latter case close fencing is required in the form of a sufficiently thick wooden lath suspended or supported under the lower side of the belt, and a little broader than the latter.

Where there is a fast and loose pulley arrangement in the drive the lath should be a little more than twice the belt width, to protect it both when driving and running idle. The lath can, of course, be replaced by wire netting or open sparred work, but the author's experience leads him to prefer the former.

Very low belting is protected in exactly the same manner as that already described for the more powerful low-set mill-gearing connections.

Belt management involves the operations of placing in position and of unshipping for repair or other purposes. In performing these the belt rests in vertical drives on the upper of the two shafts, and in diagonal drives partly on both.

In such circumstances there is some danger of the belt, by its frictional contact with the shaft, seizing upon the latter, winding up thereby, and, in quite a number of cases in the author's experience, dislodging counter-shafting and bringing parts of machinery down upon workmen. In addition, a low, idle, slowly travelling belt is a great temptation to children and young persons about factories. When gripped by such and pulled, the frictional resistance is greatly increased, and if the whole weight of the body is suspended the belt frequently, and with surprising quickness, draws the person to the overhead shafting with resulting injury, sometimes of a fatal character. Three deaths within as many years in one district came under the author's notice, through boys, who were assisting men in the repair of idle belts depending from shafts, being entangled with the former, and quickly drawn up to a high ceiling and terribly mangled by the whirling mill-gearing.

The danger from this cause has degrees, and is greatest when the driving shaft is uppermost and the

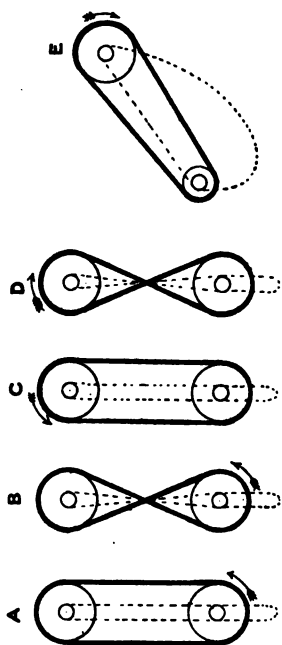


FIG. 67.

FIG. 68.

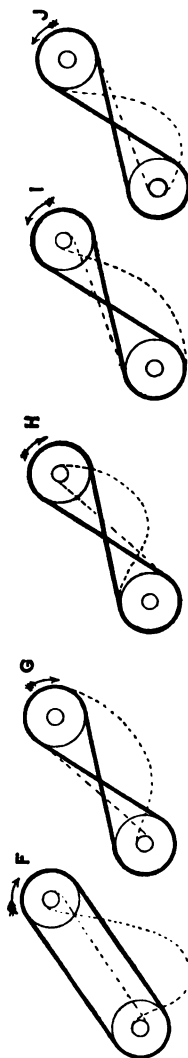


FIG. 69.

lower side of the belt is the tight one. In Fig. 67 the manner in which an idle belt seizes the shaft solely by its own friction is shown. The slack side (*a*) by contact with the tight side (*b*) is carried into the bight (*c*), and the shaft rolls up the two sides at once with resulting dangerous breakage of belt or other gear. In Fig. 68 the direction of motion is indicated by an arrow placed on the driving pulley. The least dangerous position is that at A and B, where the idle belt does not travel. At C, D, and E the belt travels but does not seize.

In Fig. 69 dangerous positions of idle belts are shown at F, G, H, I, and J, in all of which the upper shaft is

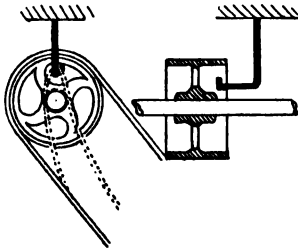


FIG. 70.

the driver, and the belts when idle tend to seize and wind up on the shaft where the slack side crosses the tight one.

The dangers both from the above cause and from contact of depending belting with workers are removed when the latter is arranged to fall upon a belt perch as in Fig. 70. This method of support is much safer than the tying-up sometimes resorted to, as the latter operation entails a workman's ascent to the shafting. Such belt perches may with advantage be extended to form a segment equal to the arc of contact of the belts (Fig.

71), and may consist of parallel rods or a continuous curved bar.

Where a pulley is situated very near a journal, on the side opposite to a belt perch, a guide-bar close to the pulley, and at the point where the belt first touches the latter in its approach, should be fitted to prevent the strap falling between the bearing and pulley, and causing damage.

The protection of machine countershafting and of the pulleys thereon when low enough to be in the headway is carried out exactly as in the case of mill-gearing, the same care being exercised regarding the protection of exposed dangerous collars and pin and key heads.

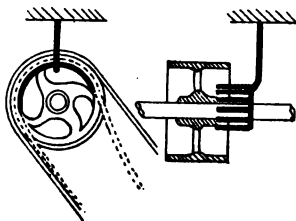


FIG. 71.

In the case of low machine pulleys driven by belts passing through the floor, fencing should invariably be applied as in Fig. 72, where A and B are the wooden box types, C wood framing filled in at side with wire netting, and D entirely of the latter material. Such fences should be latched securely to the floor or machine.

In some cases where it is not desirable to obscure the pulley, a portable wire-netting screen can be fixed quite close to it, and in others a disc of sheet metal, wood, papier-mâché, or mill board may be used to cover over the arms, and is pinned to the latter. This precaution is useful in all cases of low-set fast and loose

SAFEGUARDING OF DANGEROUS MACHINERY. 187

pulleys not otherwise fenced, owing to the shearing action between their arms.

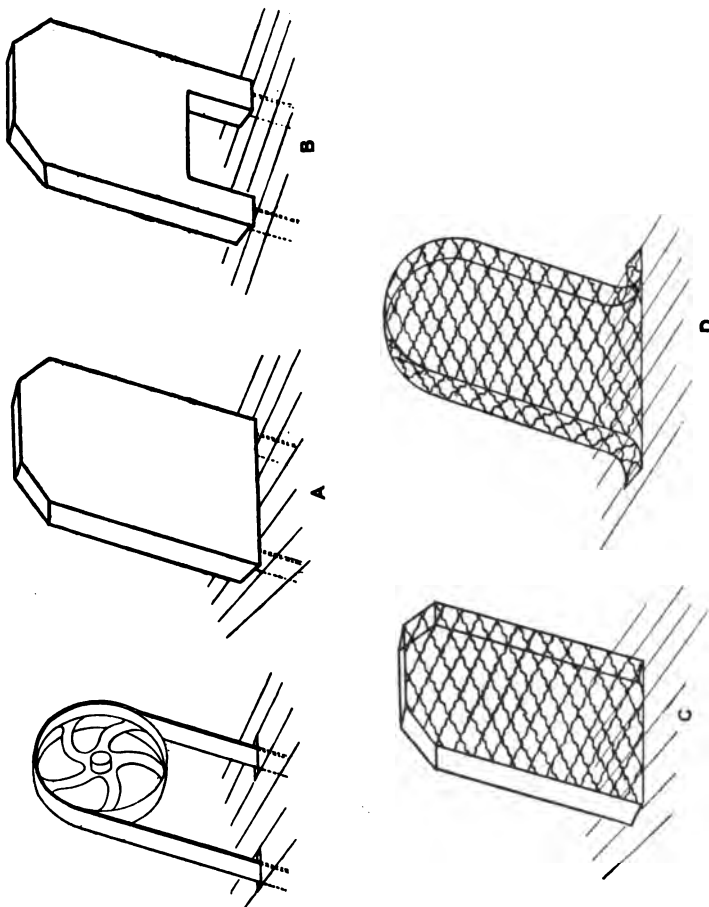


FIG. 72.

The uniform solid disc, on the outside pulleys at least, in Figs. 64 and 65, illustrating textile protection, are

examples of what might be adopted in every case, both for pulleys and machine fly-wheels and brake-wheels.

The pulley rim is most dangerous at the point where the belt first touches it in approaching. Where a well-designed fork is fitted for belt shifting, in the case of fast and loose pulleys, it should afford protection at this part, but, in the case of single pulleys, not otherwise fenced, the intake must be protected. The best method of doing this is shown in Fig. 73, where the fast-running side straps of a carding machine have Leadbeater's guard applied to the pulley intakes. It is quadrant shaped,

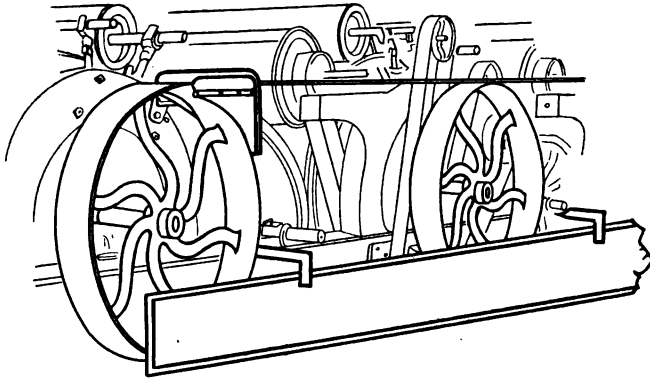


FIG. 73.

supported from the machine framing, and the side flange can be let down, without detaching the guard, for unshipping the belt. The pulley arms in such cases can be filled in as described above, or the lower side of the belt and the pulleys can be fendered off as shown in the Fig. 73. In arranging belt shifting gears care should be taken that the handle with which an attendant may have to perform the operation is in a safe relation to the dangerous parts. Fig. 74 represents a recent case, in-

vestigated by the author, in which a new machine was designed and erected with the starting handle 7' from the floor, and only 7" from the intake of unfenced powerful bevel wheels. The latter would never have been approached in motion but for the clumsy starting

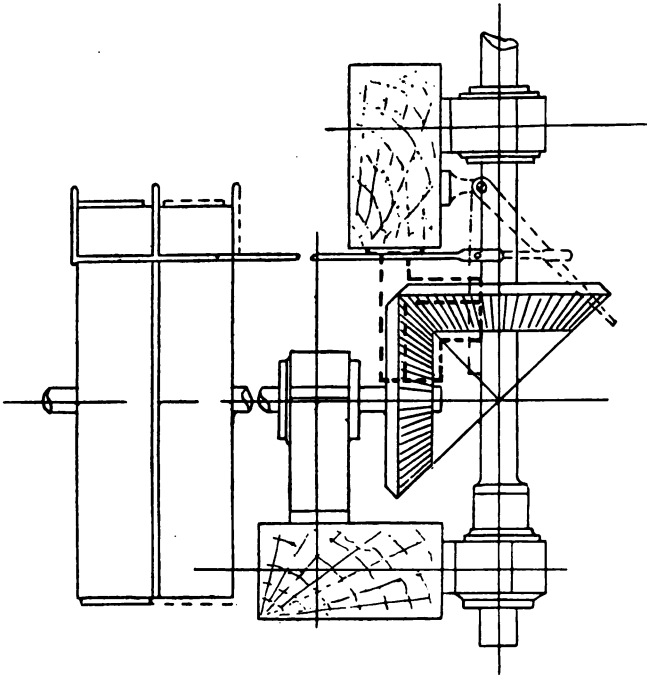


FIG. 74.

gear, and the attendant, loosing his grip one day in pushing home the bar, fell into the wheel intake and lost his right arm. The protection of the wheels, or the provision of a lever handle as shown, close to the worker, would have obviated all risk of this kind.

Care should be taken to make the belt-shifter action when removing a band to the loose pulley of a positive character, either by using one of the many forms of locking gear or a balance weight. Many accidents have arisen through the lack of this precaution, in the working back of the belt to the fast pulley and unexpected movement of a machine under examination.

Very dangerous tools worked at high speed, parti-

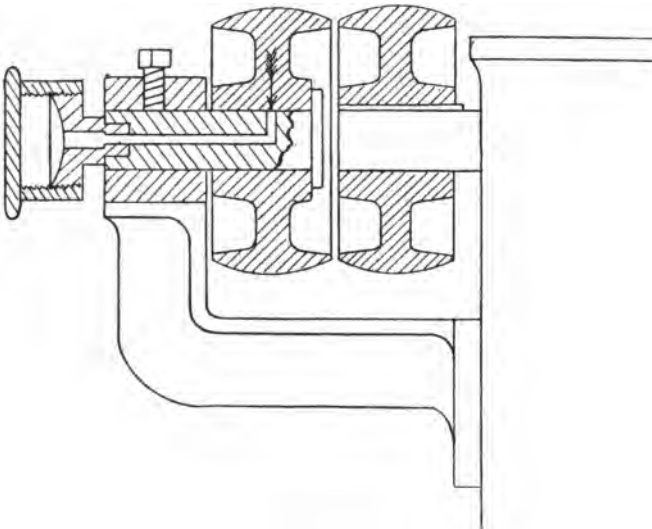


FIG. 75.

cularly saws and other wood tools, are sometimes set in motion without warning, owing to the loose pulley driving the fast one by seizing upon the shaft or by the side friction of the adjacent rims. Fig. 75 shows a remedy for this by the mounting of the loose pulley on a well-lubricated idle stud co-axial with the machine spindle, with a collar which prevents any end motion in the direction of the fast pulley. The same end may be

attained on existing troublesome loose pulleys by encasing the necessary bearing length of the shaft with a collared sleeve which does not revolve with it, and on which the loose pulley runs.



FIG. 76.

The split-grip collar described in mill-gearing details (Fig. 35) can also be used to keep such pulleys from contact, and to secure loose bushes to the shaft which take up the wear of the idle pulley.

The details considered in this chapter are those common to all classes of machinery in use, both in factories and employments external to these, and the many applications of the safeguards described will readily suggest themselves to every occupier, overseer, or operative. The pushing of belts off pulleys, where no special belt-fork or unshipping gear is provided, is easily and safely accomplished by an experienced person from the floor level with the aid of a simple pole, the side pressure of which on the portion of the strap just approaching the pulley is sufficient to remove the former to its perch. The replacing of belts by skilled persons involves little risk when the mill-gearing and counter-shafting is close fenced in the manner described in Chapter VIII., but, otherwise, the employer must reckon with the penal and civil consequences of a near approach for the above purposes to unprotected gearing.

A number of mechanical contrivances of varying merit for replacing belts from the floor level are in the market, one of which, made by Messrs. Wallach Brothers, of London, is shown in Fig. 76, and has proved very serviceable.

CHAPTER XI.

SAFEGUARDING OF DANGEROUS MACHINES.

Liability.—Machinery may be “dangerous” within the meaning of the Factory Acts (1) because of its defective construction or need of repair, or (2) from lack of efficient safeguards at dangerous places.

(1) A machine which is dangerous from the first two causes will be at once disused or put in order by all careful employers, and works rules and supervision should be framed and conducted so as to secure the due notification to responsible persons of such matters. The failure of a workman to notify defective condition or need of repair within his knowledge may, as we have seen, bar his claim in case of injury thereby to certain civil remedies for accident, but the penal responsibility of the employer remains untouched. An Inspector of Factories is empowered in the case of a machine proved to be dangerous from these causes to apply to a Court of Summary Jurisdiction for temporary or permanent interdict in the use of the machine, the exact nature of the order being subject to the discretion of the Court, which may require remediable steps to be taken within a prescribed time.

This power rarely requires to be exercised, it being in every way the interest of a factory occupier to keep his machinery in an efficient state. Defect of the kind under consideration generally retards production, and is usually repaired without judicial pressure.

(2) The liability of the occupier under the Factory Acts for neglect to securely fence "all dangerous parts of the machinery" in a factory has been referred to in the previous chapter when discussing the dangers and safeguarding of certain details pertaining to all machines.

In addition to these, however, many labour-saving

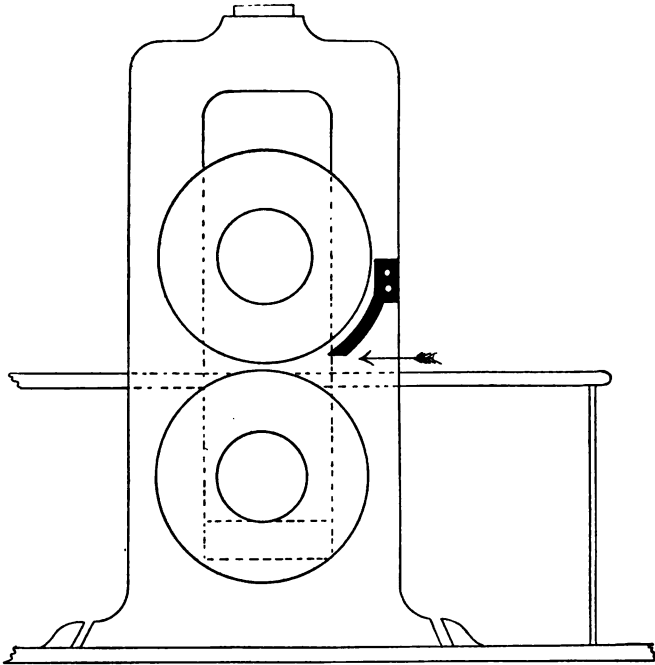


FIG. 77.

tools have special accident risks of their own, which can be met by well-considered fencing.

The compilation of a complete list of such machines is practically impossible, owing to their number and frequent modification, and in the present chapter the

application of mechanical ingenuity to the most common and most dangerous tools only is described and illustrated.

Modifications of the latter to meet special conditions in the multitude of industries throughout the United Kingdom will suggest themselves to every occupier who gives the subject the careful attention which alone can ensure immunity from preventable accident.

Rollers and Knives.—Hand-fed calendering and pressing rolls of all kinds give rise to serious accidents, the majority of which need not occur. In the case of a

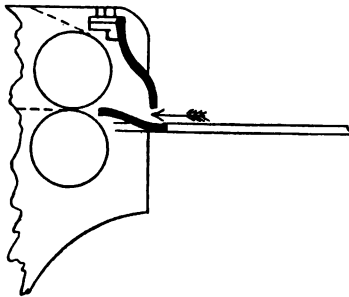


FIG. 78.

single pair of rolls used to press and smooth comparatively thin sheets of material, it is possible, by using a feed-table level with the top of the bottom roll, and guarding the intake to a short distance above the open space required for feeding, to effectually prevent an attendant's fingers or hands from inadvertently travelling forward to the rolls with the work and being seriously crushed.

In Fig. 77 this species of protection in the form of a plate is shown applied to paper glazing rolls.

In Fig. 78 it is fitted in the form of a curved bar to the

narrow rolls with a differential motion used in burnishing sheet metal.

The guard may be hinged with advantage, Fig. 79, where ready access to the roll intake is necessary, but in ordinary circumstances it is better to be fixed in position. In cases where the view of the intake must not be obscured, a wire-netting frame serves equally well as a protection. Rolls in a vertical position should always have a feed-table, which serves to keep the attendant at a safe distance from the former, and in some cases the fitting of the above protections is also possible.

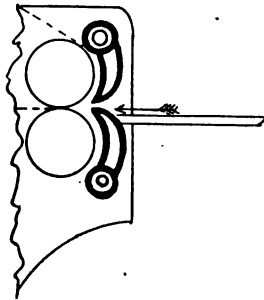


FIG. 79.

Where rolls are dealing with plastic material the plate can be replaced by a metal rod, which will not allow the hand to travel beyond it and yet affords the necessary freedom for cleaning the rolls. Such a rod, in the case of the dough-brakes used by bakers and similar machines where the bearings of the top roll rise and fall, can be attached to the inner sides of the blocks and will move with them, being always just clear of the work in hand.

Guillotines and other cutting and shearing knives can be safe-guarded by the projecting rod or wire-netting attachments described above, when placed so as to leave

an opening beneath them a little greater than the maximum thickness of the material sheared.

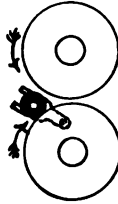


FIG. 80.

In some hand-fed rolls, such as laundry folding, pressing, and ironing machines, the metal rail or plate is not practicable owing to the character of the work,

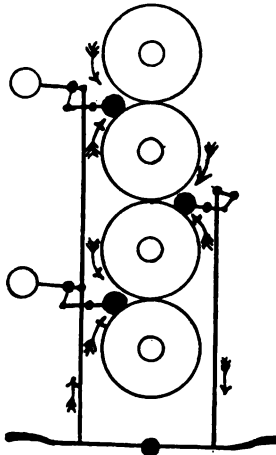


FIG. 81.

and its place can always be taken by an auxiliary light roller of wood (Fig. 80), which, though always pressing against the power drums or rolls, and driven by the

frictional contact, can rise and fall in its end bearings as the thickness of the work requires, and effectually prevents the accidental insertion of any part of the hand into the dangerous intake.

In power-fed rolls, such as those on cloth and paper-calendering machines, it is necessary to start the feed by hand and, in case of paper, to restart after all breakages of the web.

Fig. 81 shows the method of applying the auxiliary wooden roll to such machinery, and by a simple arrangement of link-work and balance weights the extra rolls can be kept in the guarding position, and released when necessary by pulling a lever.

Fig. 82 is an arrangement for starting the feed in a cloth calendering machine by means of a wooden board with bevelled edges, which ordinarily is kept by a weight above the rolls, but may be swung round its horizontal axis by hand, and used to push the cloth home until the latter is gripped.

Chaff Cutters.—A combination of rollers and knives which is responsible for many serious injuries—not only in factories but in agricultural pursuits—is found in the chaff-cutting machine.

The boxing in of the fly-wheel should always be done, and the protection of the driving belt, pulley, shaft, and feed pinions can be efficiently attained by the methods already described for such details.

The special danger of the apparatus arises when feeding hay, straw, and other bulky material by hand into the rollers.

In a recent accident which the author investigated, a man was so engaged, when a finger became entangled in the endless travelling web, and, as he was pulled down and not able to reach the stopping gear, his left arm

from the finger-tips to the elbow-joint—16"—was fed through the rolls and cut by the knives into sixty-four pieces before the former ceased to grip.

Similar shocking injuries, sometimes resulting fatally, have often been inflicted, and special provision—not applicable to Scotland, however—has been made in the Chaff-cutting Machines (Accidents) Act, 1897, for the safe-guarding of such machines, whether driven by power

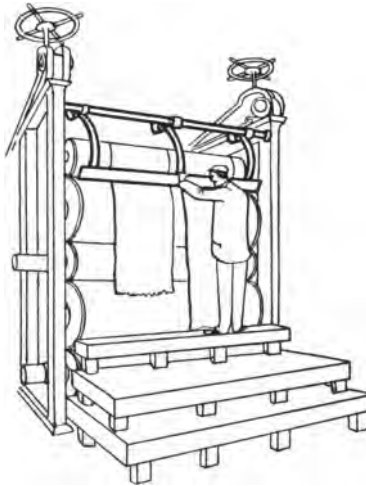


FIG. 82.

or not, in other premises than factories. The passing of this special statute has resulted in agricultural implement makers all over the kingdom applying their minds to the problem of protection.

There is not the slightest doubt as to the apparatus being "dangerous" within the meaning of the Factory Acts, and a good deal can be done to protect it, both in new and old forms.

Fig. 83 is Bentall's control gear and safety feeding arrangement, either, or preferably both of which may be fitted to mechanically operated machines. The control gear consists of three mitre wheels M M M, a clutch C moved by link-work and a lever L, and a horizontal bar B, operating L and crossing the feed-box. In position 1 of L, the material on the web moves towards R R, and, should the worker's hand travel forward, his arm is drawn

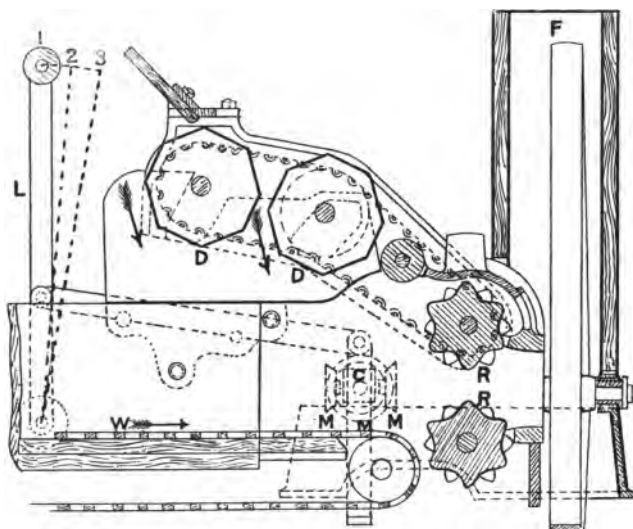


FIG. 83.

against the bar B, which moves L to position 2, and stops the machine ; any further pressure on B moves the lever to position 3, and reverses the feed motion.

In the safety feeding arrangement, two light polygonal drums of wood D D, carried by a lever hinged on the axis of the upper roller R, and operated by a chain therefrom, are arranged to rest upon and press forward, without manual assistance, the material deposited in the

feed-box. At the same time the drums, being light, will restrain the hand accidentally inserted without injuring it, and can be readily raised for examination and the cleaning of choked rolls.

A chaff-cutter with safety control and feeding gear is very well protected in the above respects.

Die and Flat Presses.—These tools are the machines which perhaps more than any others in the experience of Her Majesty's Inspectors of Factories lead to the worker becoming a mere automaton, and inflict serious injury upon the most experienced persons. The form of protection possible varies with the nature of the operation.

In cutting out tinplate, or other material, close fencing should invariably be applied to the die. In bulging or corrugating blanks already cut, the feeding may be easily arranged to take place at a safe distance from the die, and in trimming the edges of blocked-out tins, a wooden or metal holder for each size of tin can be used, which dispenses with the near approach of the worker's fingers to the die.

The method by which the punch is brought down also influences the safety of the operatives. The stroke is either continuous or intermittent. In the latter case, a foot treadle or hand lever is used to start the punch. With the treadle there exists the danger that the attendant, who has always one foot upon it, may, when extricating a spoiled blank, unwittingly give the accustomed pressure and suffer injury. When a hand lever is used, and the side of the die away from the lever is screened as in Fig. 84, this is not so likely to happen, for the hand cannot be simultaneously used for interference with the die and for starting purposes.

The puller-off, shown in Fig. 85, is a metallic ring

supported from above, with clearance for the work beneath, and, by ensuring the ready detachment of

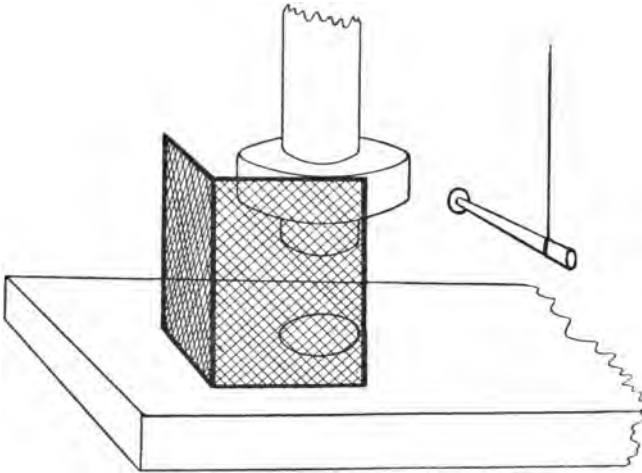


FIG. 84.

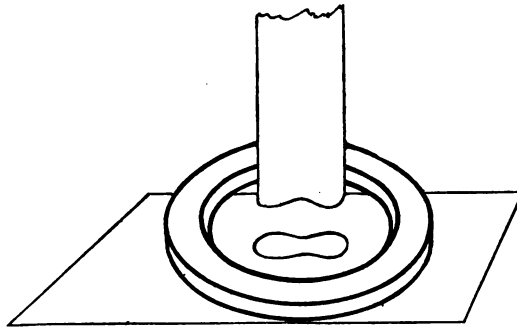


FIG. 85.

the blank from the punch, dispenses with manual interference for that purpose.

Figs. 86, 87, 88 and 89 show four methods of fencing

the ordinary cutting-out press. In Fig. 86 a bar-iron piece G guards the punch close to the die, while the space between this and the frame is occupied by a wire-netting screen W, which permits of observation. When the machine gap is wide, the screen W is continued behind the punch to prevent the insertion of fingers there, a common occurrence. In Fig. 87 the sheet-

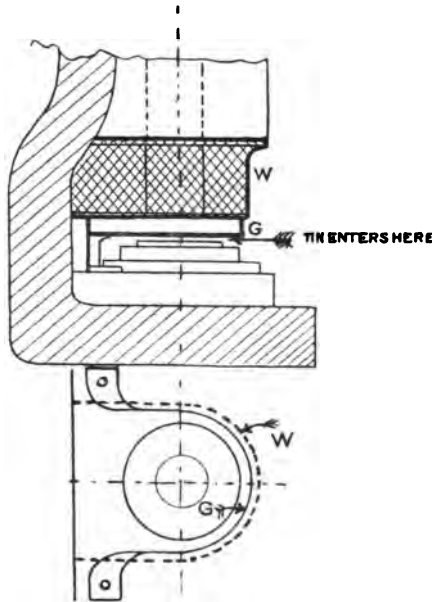


FIG. 86.

metal guard has an observation slot and is made for each size of punch, only clearing the latter by about $\frac{1}{4}$ ". Fig. 88 has a sheet-metal bridge, with observation holes, through which the tin is fed, while the punch is fenced by a close-fitting, bar-iron guard, like G, Fig. 86, which is carried round the back of the former and supported

from the bridge. In Fig. 89 a wire-netting guard, fixed in the machine front and adjustable in a vertical direction, is made large enough to embrace all sizes of punch, and the work is fed under its lower edge.

Feeding is often done by hand-pliers or pickers, and

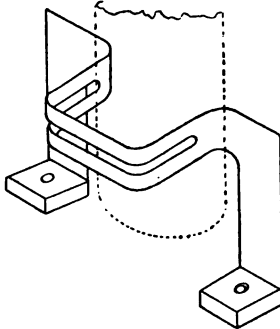


FIG. 87.

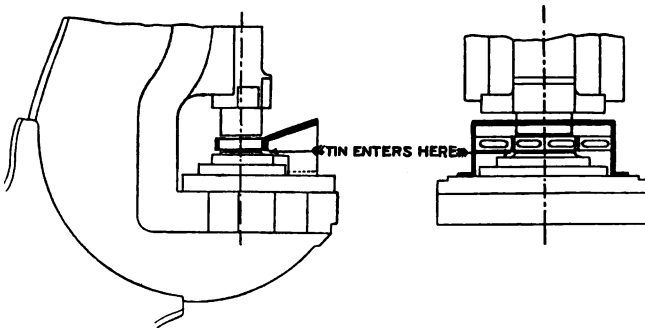


FIG. 88.

such instruments should always be provided for the extraction of spoiled work. Where lids and bottoms already stamped out are finished in a hollow die through which they drop under pressure, the feeding can be done

by means of a shoot supported from the machine frame as shown in Fig. 90. The width of the guiding edges of the shoot is a little greater than the smaller dimension

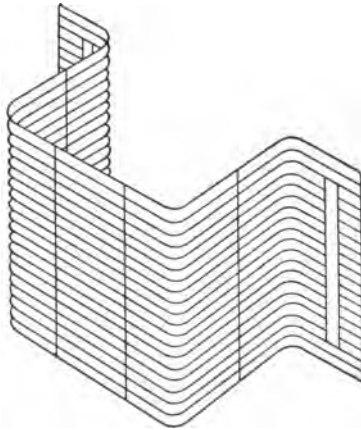


FIG. 89.

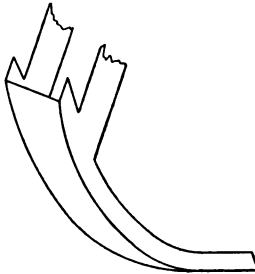


FIG. 90.

of the tinsplate, and the latter is brought up in the proper position on the die by means of a stop thereon.

In Fig. 91 a form of straight shoot, usually inclined when in position at about 50° to the vertical and an integral part of the die, is shown, which has adjustable

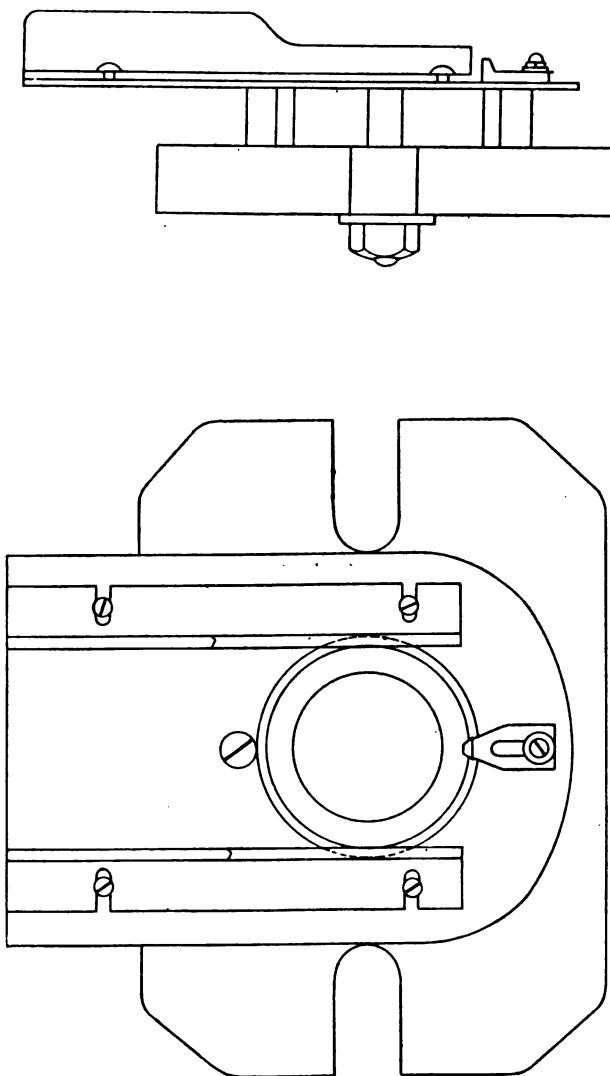


FIG. 91.

angle iron edges and the stop pin already referred to, and, in addition to being useful for various sizes of work, the latter is ejected on the rising of the punch owing to the resilience of a volute spring beneath the die which is compressed at each downward stroke.

In flat pressing various simple contrivances in the form of wire netting, bars, and rods can be adopted for safety in hand-feeding.

The ordinary "Arab" and other job-printing machines give rise to accident when feeding by hand at high speeds, and Bulford's method of preventing the insertion of the fingers between the moving and fixed tables is shown in Fig. 92, where a wire-netting or grill screen,

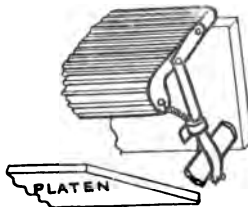


FIG. 92.

supported by side-links from the parallel motion of the machine, pushes aside a finger inadvertently projected and covers the dangerous opening before the impression is taken.

Grindstones.—Such tools when used, as they largely are, only for tool sharpening, are driven at speeds which never tax the ultimate tenacity of their material. In such cases they only give rise to accident through breaking up in motion when originally faulty or because of fracture in careless handling, mounting, or redressing. The examination and treatment of stones is dealt with below.

One other preventable cause of accident, however, in tool grindstones requires to be noticed. Workmen, and particularly apprentices, frequently hold their tools at such an angle to the rest of an approaching stone that the latter are seized and, along with the operator's hand, are suddenly jammed in the slight clearance between rest and stone and seriously crushed. The author

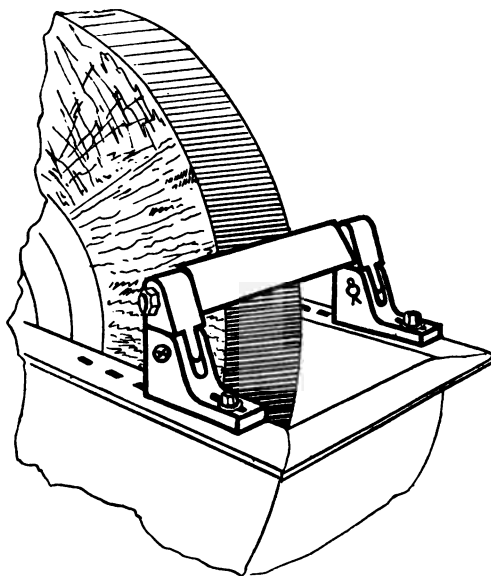


FIG. 93.

has met with quite a number of persons permanently incapacitated from following their skilled handicraft through an accident of this kind, the consequences of which can be obviated by the use of a releasing rest, such as that of Messrs. Addy & Johnson shown in Fig. 93.

In the cutlery and other grinding trades where the use

of stones of all sizes predominates for manufacturing and finishing purposes, they are run at high speed, and special precautions have to be taken to ensure safety. The same attention should also be paid in the grinding shops in engineering, grate-founding, and other establishments. The latter, however, are not usually conducted on the piece-work or tenement factory system, and the stones are, as a rule, more carefully treated, and are examined and replaced with greater deliberation.

The stone itself may be initially bad, and the following are the principal points to which attention should be given. The use of explosives in quarrying the material should be avoided, and manufactured stones obviously not homogeneous and with cross veins should be rejected. Unfortunately there is reason to believe that the piece-work system obtaining at the quarries and dressing-sheds encourages workmen to conceal in various ways, under fear of pecuniary loss, defects which afterwards cause injury and even death. The finished stones also should have round, not square axle holes. The "jumping" of the latter form at the quarries through stone centres is apt to start minute radial fracture, and this is sometimes increased by unsuitable mounting. The porosity of the stone necessitates its storage in a dry place, otherwise it becomes water-logged and heavy-sided or softened before use, and may even in winter be obviously or secretly fractured by the expansion of the absorbed moisture in freezing.

In mounting stones for work the use of wedges driven into square holes should be avoided as calculated to set up injurious stress when swollen with moisture: metal plates adjusted to bear equally all round are in every way safer. Racing, *i.e.*, balancing an unequal stone by tooling surplus material off its sides, should be carefully

done, and it is sometimes possible to detect flaws in this operation.

The testing of stones is variously carried out. In some factories a new stone is run at a speed from 25 to 50 per cent. greater than its working rate, sometimes under a strong guard, but usually only with the workplace cleared for the time being. In the case of stones with serious fault this test results in their destruction. Other occupiers rely upon careful examination and

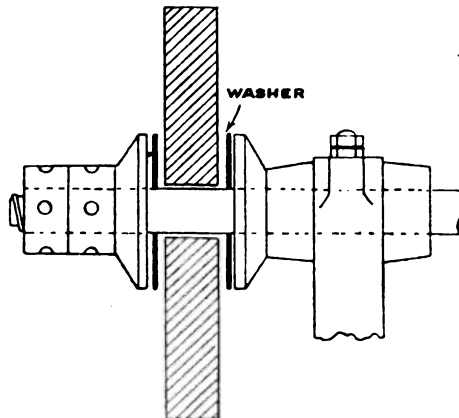


FIG. 94.

tapping for the detection of unsoundness, and only run the new stone idle at its *ordinary* speed for a short time during the absence of the workers.

For the same reasons affecting careless storage, the idle mounted stone in wet grinding should not be left overnight, or for any long period, with a portion immersed in water; and in trueing up the stone, when unequally worn, care should be taken not to hack the rim with undue violence, as radial fracture is thereby encouraged.

The regulations of the Act of 1895 regarding the position of the grindstones in tenement factories and the safeguarding of their gears, are dealt with in the next chapter along with the other trades subject to special statutory provisions for prevention of accident.

Emery Wheels.—Composite discs of this kind for

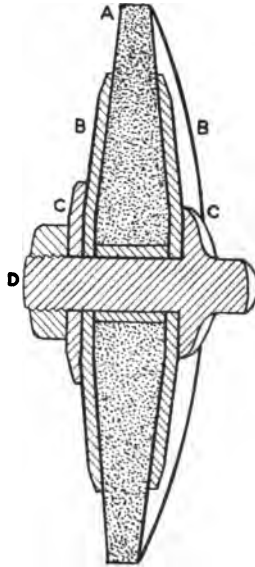


FIG. 95.

abrasive purposes are used in large numbers in the metal industries, but they do not attain the dimensions of the ordinary grindstone.

The manufacture of emery wheels is under control, and a bad wheel is generally a cheap one. In two recent cases of bursting of emery wheels, the author found that the users had accepted offers to supply

wheels at prices for which no maker could produce a good article.

Emery wheels should on no account be wedged, keyed, or driven tight on to the spindle. Fig. 94 shows the method of safe mounting, a disc of india-rubber or of dry cardboard being used on each side between the loose flanges.

Fig. 95 is Messrs. Pfeil's cone-sided wheel, in which,

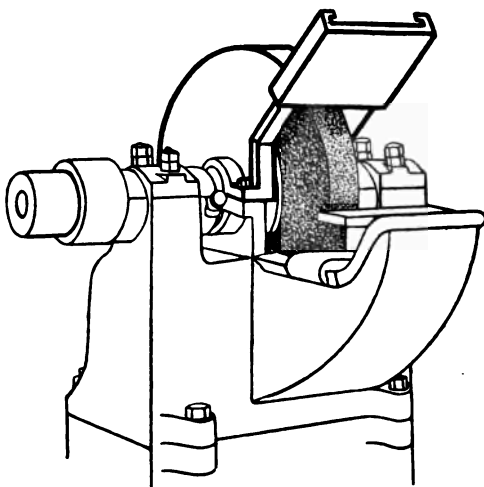


FIG. 96.

in case of a fracture extending from the centre, the taper of the pieces between the washer plates prevents their escape.

Ordinary tool-grinding wheels can be effectively hooded as shown in Fig. 96, where a strong malleable iron or steel closed hood several times wider than the emery ring is used. In the case of destruction of the ring from any cause the hood can contain the broken pieces,

thereby preventing the mounting of the latter which always occurs with a close-fitting hood, sometimes with serious results. On the top of the hood and in front of it a strong, adjustable slide is fitted, which can be brought down to the periphery of the ring, thus preventing the broken pieces from flying out.

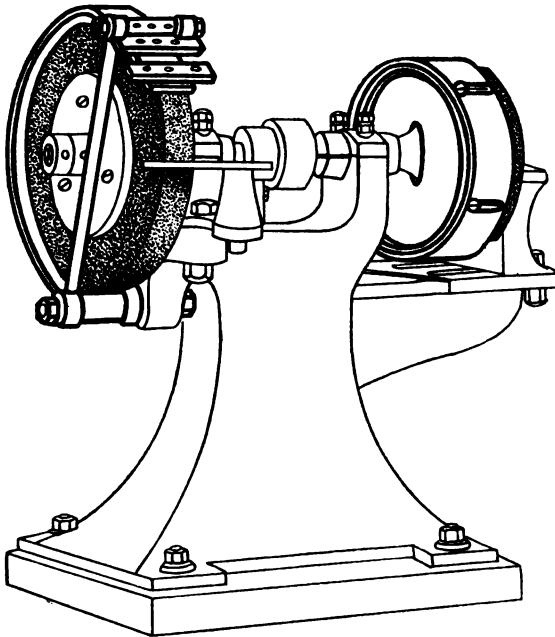


FIG. 97.

Fig. 97 shows the nature of the protection required at overhung disc and face-grinding wheels. At the former a strong curved bar is hinged at the bottom of the disc, and the upper end is anchored securely by side tie rods. The edge of the face wheel is enveloped by a strong wrought-iron ring, which can be adjusted as the thick-

ness of the wheel reduces through wear. The two examples just illustrated are products of the London Emery Works Company.

Fig. 98 shows the method adopted in some spindle and twist drill factories for protecting overhung emery wheels subject to rapid wear and shock, and which require to be readily dismounted and replaced. The hood in this case is made in sections, and is not a part of the machine frame ; the top being of steel, or thick

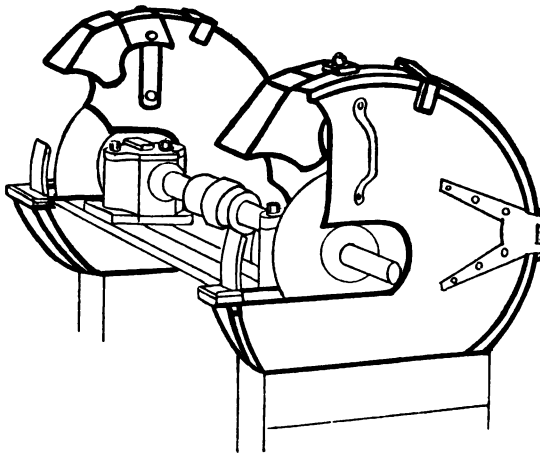


FIG. 98.

cast iron, and the sides of sheet iron. The side next the belt is fixed, while the top and the side from which the wheel is put on are ordinarily clamped to the former, but are made to swing aside together on a vertical hinge for renewals. An adjustable additional cap is provided as a continuation of the hood-top. It may be tilted or, preferably, pierced with holes for light. The flat front slide, illustrated in Fig. 96, sometimes takes its place.

The whole protection casing described can be shifted back or forward parallel to the side of the wheel to accommodate worn wheels or those of varying dimensions.

An emery wheel requires the same careful handling and freedom from unnecessarily rough treatment as the grindstone, and in the case of both tools the framing must be heavy, without spring, and bolted to a solid floor or foundation, if injurious and dangerous vibration is to be avoided. The ultimate tenacity of the cementing agents used in emery wheel construction is variable and known only to the manufacturers.

In order therefore to avoid accident from excessive centrifugal stress, the speed tables and instructions issued with the wheels should be strictly adhered to by users.

Circular Saws.—These widely distributed machine tools caused five deaths and inflicted 1139 non-fatal injuries during 1898.

The danger from wood coming over or past the saw, and persons stumbling or falling against the latter either when passing the bench or feeding at the same, are well known, and considerable progress has recently been made in the adaptation of safeguards.

Perhaps the important contribution already emphasized which manufacturers of machinery can make towards the prevention of accident, is nowhere more strikingly illustrated than in the evolution of circular-saw protectors.

Up till a short time ago the piece of bevel-edged steel, equal in thickness to the saw, placed at the back of the saw-gate, and known as the "riving knife" (Fig. 99), and a guard extending the knife principle to more or less of the saw circumference, were about the only contrivances

regularly in use, and that in a very limited number of factories, for guarding purposes.

Since the Home Office, believing that efficient protection was practicable, began to press the matter, the four or five guards of a few years ago have multiplied more than six-fold, and in the search for novelty inventors have perhaps in some cases given utility a second place. At any rate the users of tens of thousands of saws throughout the United Kingdom can no longer complain of lack of choice in selecting a safety shield.

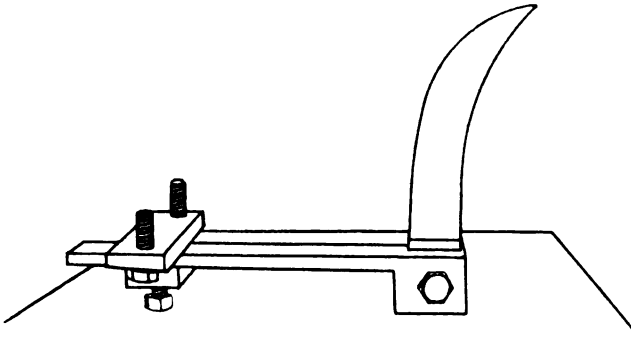


FIG. 99.

At the outset it should be clearly understood that there is no such contrivance as a universally applicable saw-guard, for the extent to which protection is possible is determined by the nature of the work done.

The fencing by movable doors or lids of all openings in the bench to the lower part of the saw should be invariably carried out for every variety of the tool.

In the present notice there are described and illustrated typical guards for the upper half of the saw, and in doing so it will be convenient to treat separately

of *rack bench saws*, *cross-cutting saws*, and *ordinary wood-converting saws*.

Rack Benches.—In treating native timber on such benches the saw is frequently entirely buried in the logs, and no *close* protection is therefore possible, though the riving knife (Fig. 99) can be easily applied, and will prevent the closing upon the saw, and consequent violent projection towards the sawyer or workers in the neighbourhood of rinds and light wood.

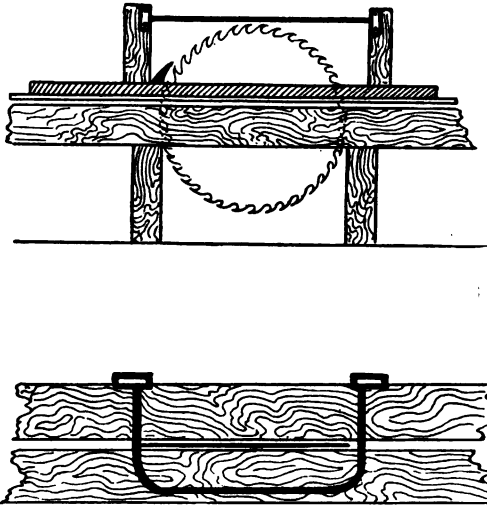


FIG. 100.

In some factories rack bench saws are used for converting timber already sawn from the round, and in such cases the secure protection detailed below for fixed benches must be provided. To prevent any person falling upon round timber saws, an adjustable rectangular iron frame may be supported from the stationary part of the bench at the level of the saw-

top (Fig. 100), or a hinged, adjustable sparred shield such as Lambert's (Fig. 101), may occupy the same position. These and similar top coverings, which leave the whole saw fully in view and free for use, are all the guards which as yet have been found of practical service on rack benches dealing with round timber.

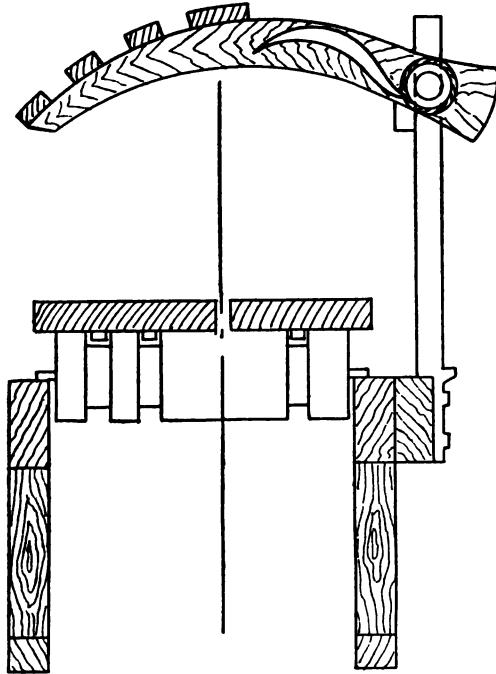


FIG. 101.

Cross-cutting Saws.—At benches used only for this purpose and for limited depths of timber, the adjustments required in ordinary guards can be dispensed with and the protection can take a very simple form.

Fig. 102 is an inexpensive wire-netting, sheet-iron,

wood, or other hood, for a bench at which cross-cutting to gauge of several thicknesses of thin timber is regularly carried on, as in packing-box and other wood factories. The hood is overhung from the back where it is secured to a hinge on the fixed portion of the bench, while the wood is fed by hand or sliding-gauge table, and the operator's hands need never approach the saw teeth.

All the efficient but more complicated guards for converting-saws which leave the bench clear of any fixing opposite the saw can also be used for cross-cutting protection.

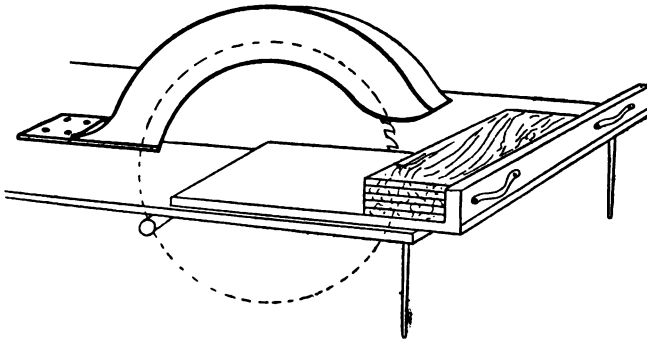


FIG. 102.

Converting Saws.—In many factories only one bench is maintained on which various diameters of saw are used, necessitating frequent adjustment and requiring an adaptable guard. It is in this direction chiefly that mechanical ingenuity has found an outlet, first in making the protection suitable for different sizes of saw, and, latterly, in securing by automatic means the necessary adaptability of the guard, both to the size of the saw and of the work. It was the neglect to provide in a simple way for these requirements which so long pre-

judged such protection in the eyes of the practical sawyer.

The current saw shields are mostly on the hood or the

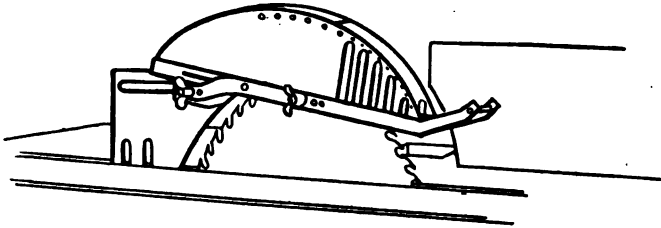


FIG. 103.

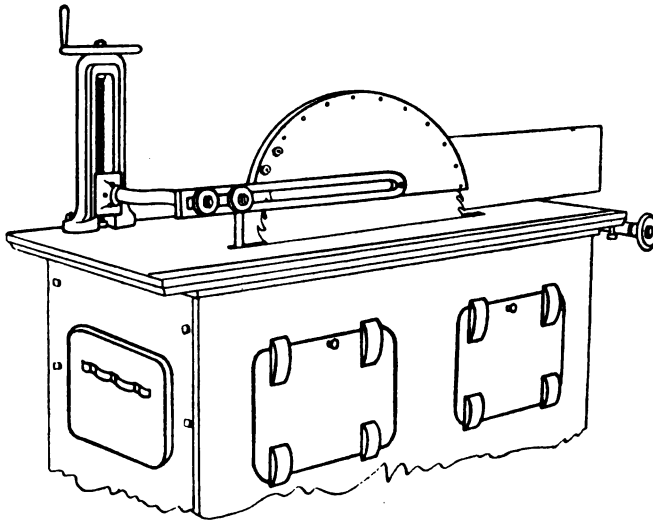


FIG. 104.

living-knife principle, or combinations of these, and the object aimed at is the protection of back, top, front, and side of all sizes of saw, with the maintenance of all

necessary freedom at work, a clear view of the line of the saw and ready access for sharpening and renewals.

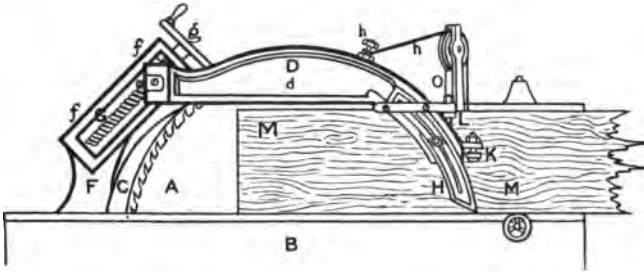


FIG. 105.

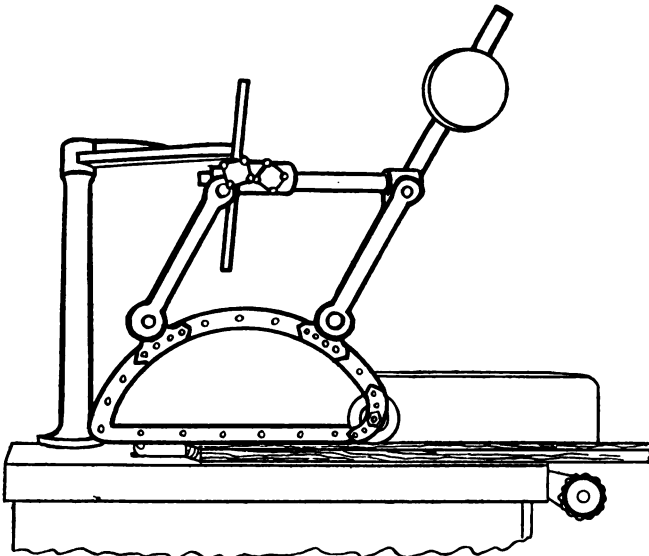


FIG. 106.

Fig. 103 is the "Kirchner" tilting hood, for many years in use on the continent. It is supported upon the

iving knife which is elongated for this purpose. It gives a clear view of the saw, and has no bench fixings.

Fig. 104 is the "Woodhouse and Mitchell" shield, with screw-block motion in a vertical plane, and horizontal adjustment in the saw plane.

Fig. 105 is the "Victor" shield, with tapering top flange, and simultaneous screw-block motion horizontally and vertically. It can also swing aside altogether on a vertical hinge, and has ordinarily a limited swing outward, controlled by a weight, to accommodate various

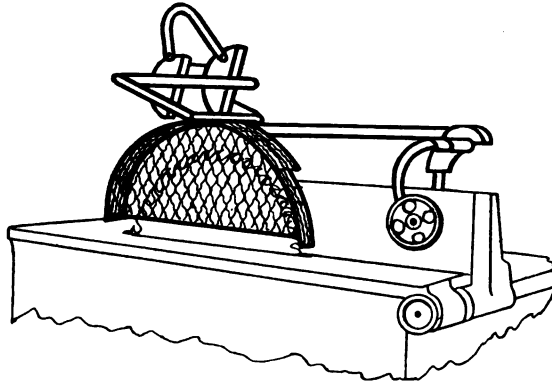


FIG. 107.

thicknesses of cut. This motion can be dispensed with for broad timbers.

Fig. 106 is the "Nonpareil," a balanced hood, moving parallel to the table top and taking up its position by pressure on a roller from the work fed on to it.

Fig. 107 is a similar balanced hood protection, known as the "Self-acting" guard. It is of wire netting, and takes up the proper position automatically when the work lifts a pulley close to the guide fence.

A number of other hood guards are made which also

rise automatically, either in vertical guide bars or constrained by balanced link-work and parallel motions.

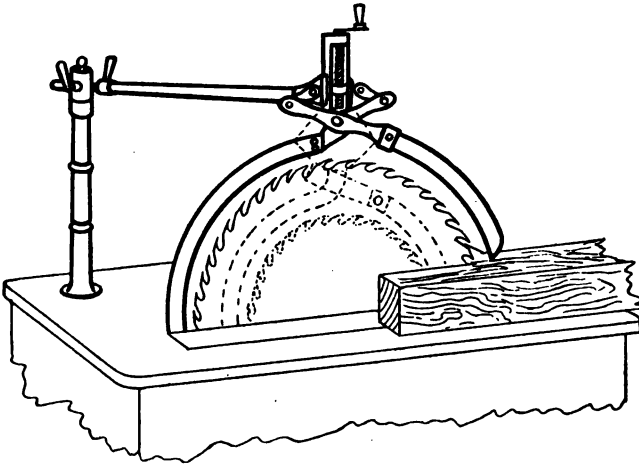


FIG. 108.

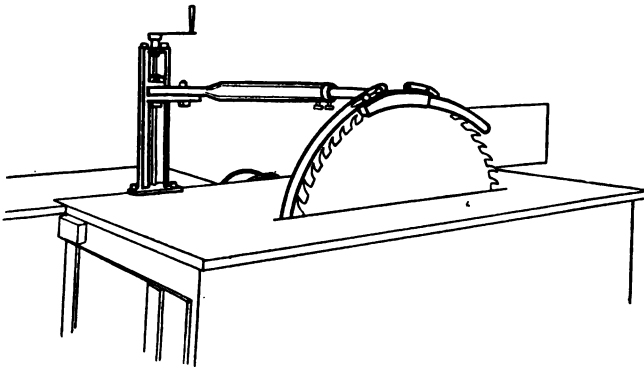


FIG. 109.

Fig. 108 is Tayler's latest form of his guard on the riving-knife principle, now made adjustable to varying saw diameters.

Fig. 109 is "Cook's" guard, in which the bench is left free for cross cutting. It is a combination of the extended riving knife and front shoe, both of which are adjustable, while Fig. 110 is a very well finished and neat guard—the "Ideal"—in which the same principle is given effect to in a different manner, and the shoe is pierced to give a view of the saw line.

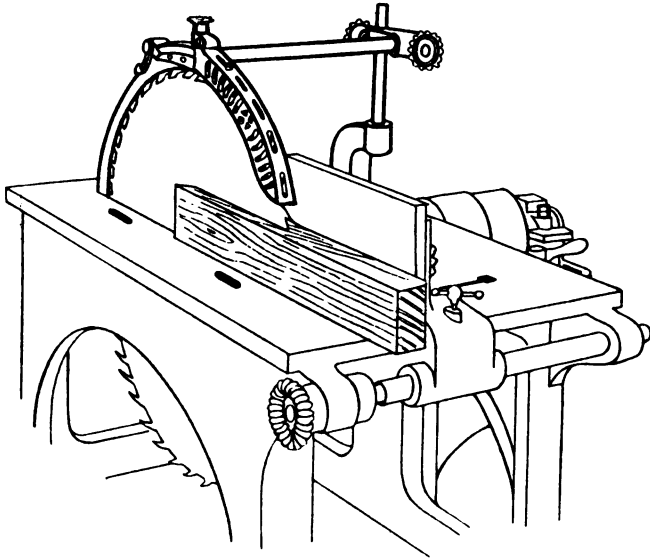


FIG. 110.

Fig. 111 is a novel form of adjustable shield—the "Anderson" guard—in which segmental U-sectioned metal pieces are hinged to each other and linked to connecting rods. The guard folds up sufficiently to allow the work to pass, and falls immediately after into the protecting position.

Fig. 112 is the "Eclipse" guard, also on a novel principle, with parallel bar and sheet-metal protection

over the saw, adjustable riving knife behind, and automatic bar fence running on rollers in front.

In all forms of saw guard care should be taken to

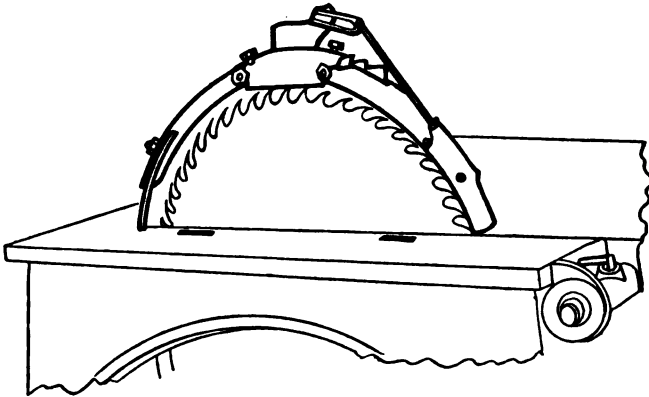


FIG. 111.

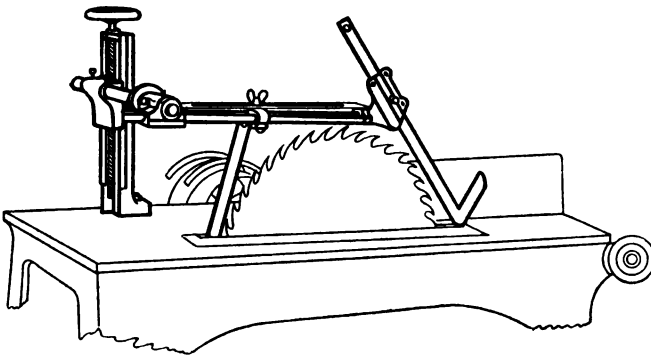


FIG. 112.

provide a well-secured riving knife, and by means of a stop pin or collar to prevent the accidental descent of the hood or other protection upon the saw teeth. This

is less likely to occur with hand-wheel adjusted guards, where a screw block gives the raising and lowering motion, and with automatic hoods, which are always clear of the largest saw when in the lowest position.

Band Saws and Blades.—The band saw may cause accident through contact with the pulley spokes and portion of saw below the table with the uprising and downrunning portions above the bench, and through cuts from fractured portions of an unconfined saw.

Fig. 113 shows a well-protected band saw, in which wire netting, wood, or other material may fence the moving parts below the bench and at the top pulley, and tubing or wood guides may protect the vertical portions of the saw not used in cutting. When the upper pulley is low set it is necessary to screen the whole of it by extending the shield downward.

In band blades used in clothing factories for cutting out to pattern, the machines have a large gap and low set top gear, which necessitate the screening with wire netting or opaque material of the whole upper portion.

Wood Planers.—In mechanically-fed machines a fixed hood protection over the horizontal cutters is easily fitted, and is useful also in arresting and directing wood chips and shavings. At hand-fed surfacing and edging machines, however, there is much danger from amputations of fingers and hands, and scores of persons every year are partially or wholly incapacitated from following their handicraft owing to injuries received from these dangerous machine tools.

Where a great deal of edging work of uniform thickness is to be performed on a narrow table, the part of the cutters not in use can be covered by the ordinary cast-iron "frog-plate," or guard furnished with the machine, and which overhangs the tool gap.

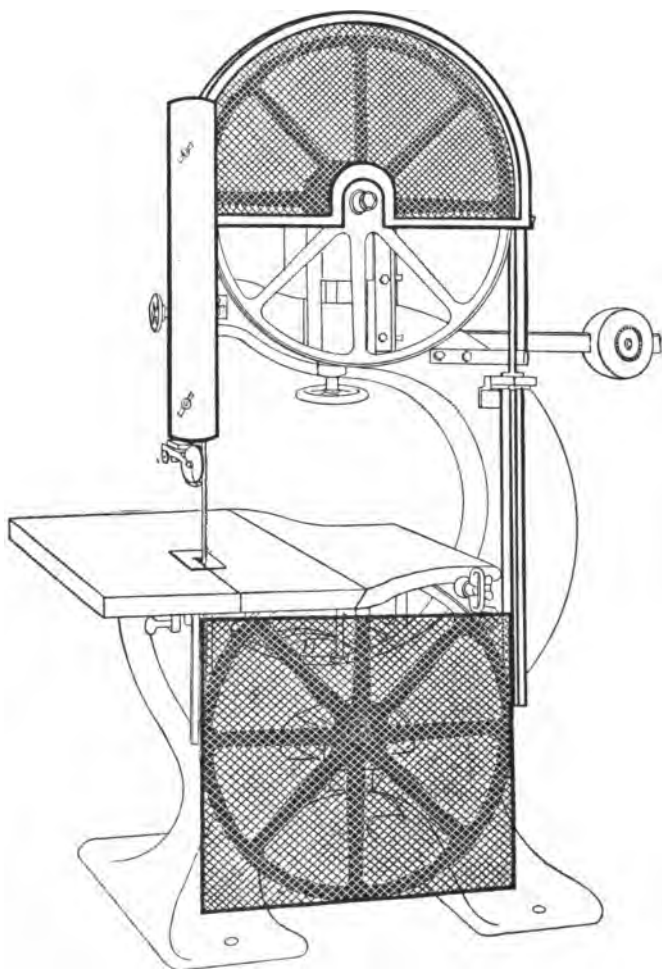


FIG. 113.

In the great bulk of cases, however, where wood of various sizes is constantly being dressed, this heavy plate-guard, with its cumbersome adjustment and insufficient width, is discarded, and some more effective and readily adjustable protection must be afforded. A vertical and horizontal movement in the plane of the machine-axis and a folding or swinging aside action for access to the cutters, or for rebating, must be possessed

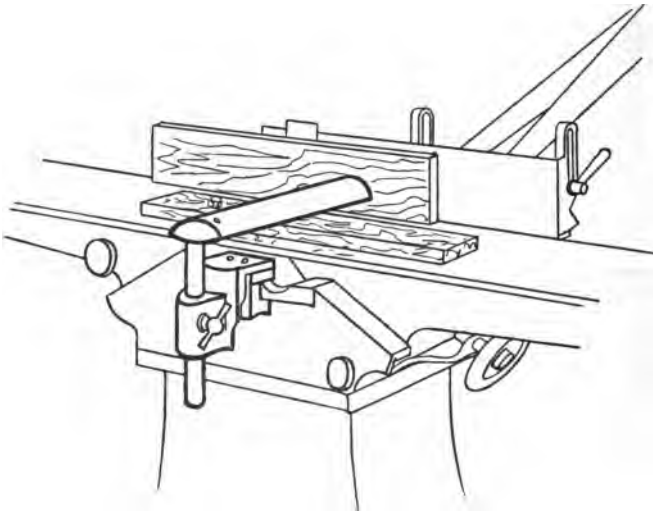


FIG. 114.

by every efficient planer-guard. Three contrivances for these purposes are illustrated.

Fig. 114 is "Campbell and Greenwood's" guard, in which a horizontal light brass cover over the cutter gap is mounted upon a bar with a vertical adjustment, slides horizontally as well, and can be swung lengthwise across the spindle-bearing.

In Fig. 115—“Bradbury’s” guard—the vertical motion is attained, within limits, by rotation at the end of a radius bar, the position of which is adjusted by a quadrant and thumb screw, thereby necessitating

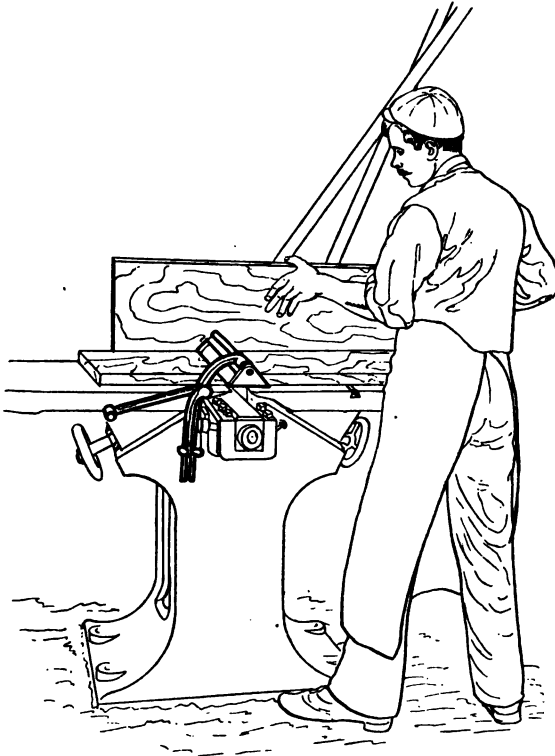


FIG. 115.

no interference with the spindle bearing. The cover slides along a turned rod to protect any desired length of the cutters, and the whole guard, without detachment

of any kind, can be swung under the table when adjusting cutters or rebating.

Fig. 116 is the "Kirchner" guard, perhaps the oldest effective planer protection, which is now finding a greater vogue in this country. The principle is the same as in Fig. 114, but without detachment the cover can telescope, can be housed on the bearing, is also hinged to fold over

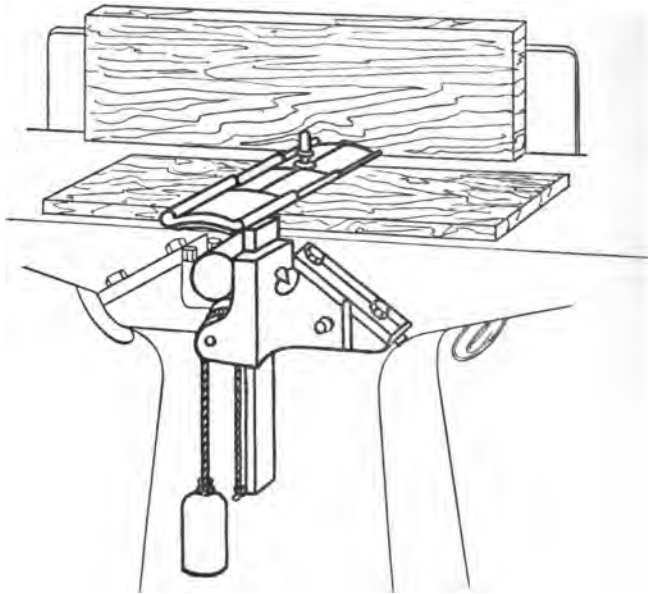


FIG. 116.

the side of machine, and is balanced in its vertical motion by a weight and pulley.

Wood Moulding Cutters. — These high-speed and dangerous tools are usually mounted on vertical spindles and require protection. Some factory occupiers provide simple wood or sheet-metal shields for the various dia-

meters, but in the great majority of cases this is not done, and an adjustable guard must be furnished for accident prevention. In Fig. 117 the "Campbell and Greenwood" spindle tool guard is shown in action for straight moulding, while in Fig. 118 its application to

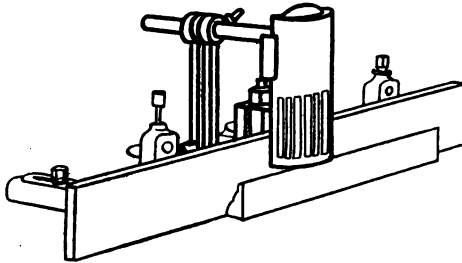


FIG. 117.

circular work is illustrated. The guard mounting has a horizontal and vertical adjustment, and the convex cover of sheet metal is pierced for observation, and can also rise and fall. Fig. 119 is the "Robinson" protector

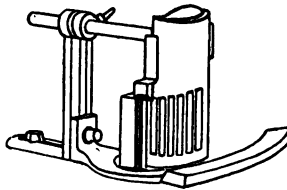


FIG. 118.

concentric with the spindle, and consisting of an adjustable sparred cover and ring.

Miscellaneous Apparatus.—Amongst other dangerous machines and processes, the safe-guarding of which is now quite practicable, are shuttles in the textile industries.

To these "Marshall's" and other forms of guard have been applied with success on many thousands of looms.

The use of locomotives in factory work requires special regulation if accident is to be avoided. Service rails upon which they run are necessarily laid within the curtilage of shipbuilding, iron and steel, blast furnace, and other works, and footways alongside and across the same are used with more frequency and danger than ordinary enclosed permanent ways.

The use of the pole and hook in coupling, and of

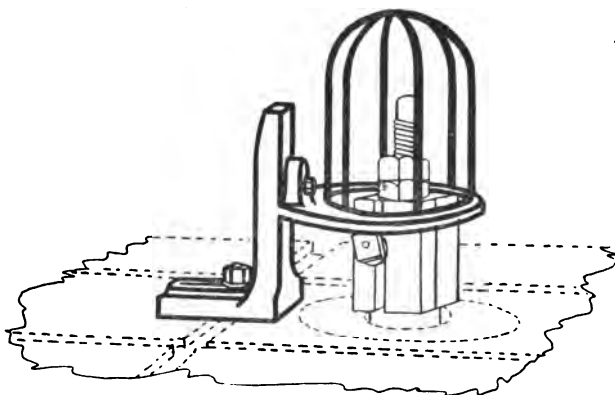


FIG. 119.

proper appliances in spragging and shunting, should be insisted upon, and the efficient lighting of the portion of the railway near factory buildings should receive careful attention.

Very youthful and inexperienced stokers and drivers are sometimes found on small factory locomotives and locomotive cranes. The author has met with quite a number of fatality cases directly caused by the recklessness and indiscretion of such incompetent attendants,

both in running and in the care of the machinery entrusted to them. No rubbish should be deposited alongside the railway, and special provision should be made for discharging engine ashes, and for cleaning and examination.

No factory railroad is safe which does not clear a wall or other fixed structure sufficiently to allow of shelter for persons overtaken by traffic, and all platforms and elevated gantries for loading and unloading should be efficiently railed round.

Locomotive traffic within factory boundaries should be in every case conducted under well-defined regulations, embracing the above points and the requisite code of signals and warnings, if safety is to be ensured.

CHAPTER XII.

SPECIAL SAFETY PRECAUTIONS.

IN addition to the general safe-guarding requirements of the Factory Acts, the application of which has been illustrated in the five foregoing chapters, special regulations are in force applicable only to prescribed persons, machinery, and processes. The latter requirements are either contained in the Statute, or embodied in the Special Rules which the Secretary of State is authorised to establish in trades which he has certified to be dangerous.

In the present work we are only concerned with the special safety precautions directed towards the prevention of accident or bodily injury.

These have been summarised in Chapter III., and the full text of the Law and Special Rules on the subject is contained in Part III.

In the present chapter the regulations referred to are dealt with topically, and their general utility is indicated.

Under the Statute.—The special provisions of the Statute may be conveniently grouped under *Employment, Position of Machinery, Fencing of Grinding Machinery, and Safety of Structures.*

Employment.—The children, young persons, women, and male adults recognised by the Acts share equally in the benefits of the safe-guarding provisions already dealt with. These classes, however, are treated differentially in connection with restrictions placed by the

Statute upon employment. A child (under 14) must not be allowed to clean any part of the machinery in a factory, whether fixed or moving, while the moving portion is being operated by mechanical power, but machinery may be moved by manual labour while cleaning by such persons is proceeding. The incidence of this regulation is almost entirely upon the textile industries, in which serious accidents have occurred to children while cleaning even the fixed portions of machinery in motion, and a claim by textile occupiers to legally permit the latter operation was decided in the negative by the High Courts on appeal.

A young person (14 to 18) must not be employed in cleaning any part of the "dangerous" machinery in a factory while the moving portion is operated by mechanical power, and neither a child, young person, or woman may clean the "mill-gearing" of a factory under the same conditions.

In textile industries particularly, while the prime mover is at work, cleaning and examination has to be performed within rectangular spaces, bounded on three sides by fixed structures and on the fourth by a reciprocating carriage with a quick return motion.

A child, young person, or woman may not clean or work in this space when the carriage is in motion.

Even when such employment is proceeding with the travelling parts at rest, the accidental starting of the latter, if on the quick inward run, is almost certain to cause serious if not fatal injury to persons at work within the dangerous area owing to the rapidity of the motion, and the Statute now forbids such employment of children, young persons, women, and *men*, unless the traversing portion of the self-acting machine is stopped on the outward run. In the latter case the completion

of the slow outward movement and the noise of reversing gear give warning to a person in danger from accidental starting of the machinery. The net result of these employment regulations, so far as male adult labour is concerned, is to leave the latter almost free of restriction; but though employment of men at "mill-gearing" and "dangerous" machinery, and of women at the latter, is not forbidden by Statute, the absence of fencing which would have obviated an accident arising out of such conditions of work entails heavy penal and civil liabilities. An employer is therefore consulting important personal interests when he takes steps to prevent dangerous employment about machinery on the part of classes of persons upon whose work in certain respects there is no statutory restriction.

Position of Machinery.—With respect to the placing of machinery in relation to walls and passages, the Factory Law lays down regulations only in the case of self-acting machines, such as the spinning mules referred to above, and the similar automatic reciprocating machines used in any other trades. Any confined space over which any person is liable to pass, and towards which the carriage runs out, must have a clear 18 inches of passage way between the carriage and the wall or other fixed structure not part of the machine while the former is fully out. The use of a machine not complying with this requirement, and the allowing of a person to be within the dangerous space, are both regarded as contraventions of the principal Act.

Danger, however, not specifically dealt with under the Acts also arises in connection with limited clearance between other travelling or reciprocating machine parts and walls or fixed structures, as well as the openings in the fixed framing which they pass. The author has met

with more than one case of death from such a cause. In certain large lithographic and letterpress printing machines the frame openings are of considerable size, and articles such as soap, etc., are sometimes stored for convenience just inside a space which the carriage or table moves over with very little clearance.

A woman, not long ago, who reached through such an opening for an article, was instantaneously killed by a blow on the head from the table of a lithographic machine.

Readily adjustable sheet-metal doors, such as those illustrated on the cotton carder frame (Fig. 64), can easily be adapted for this purpose, and end clearances of less than 18 inches should be effectively barred off from use as a passage.

Fencing of Grinding Machinery.—Tenement factory grinding is practically confined to the Sheffield and Birmingham cutlery and small arms trades, and is the only industry which has been made the subject of special statutory fencing regulations. In such work owing to the number of separate small occupiers in the same building, and even room, using a common motive power, it has been found necessary to make the owner responsible for the greater part of the safeguarding.

The occupier must see that any chains or hooks supplied by him to anchor the grinder's seat and check to some extent the upward movement of a flying stone, are sound and efficiently secured.

The owner must observe the same rule regarding any such provision furnished by him, and must provide for instantaneous communication between each room of the tenement and the prime mover and steam generator. In addition, the owner is responsible for the efficient

close fencing, on the lines already laid down in this work, of mill-gearing shafts, drums and pulleys, grindstone pulleys and belts, and the passages over and around the same ; while, except in the case of the small grindstones used by table-blade and scissors grinders, the owner must not arrange stones to run before fire-places—at which men gather to dry their clothes and their work—or in front of another grindstone. All new floors must be constructed with facilities for draining and removing grit. The owners of all grinding rooms established after 1st January, 1896, are required to conform to the following additional safety regulations, *viz.* : the efficient drainage of floors and removal of slush, the running of grindstones out of the line of doors or entrances, and the maintenance of clear spaces of at least 3' 0" and 4' 0" between each pair of troughs in light and heavy grinding respectively, and of a space of at least 6' 0" in front of each trough.

Safety of Structures.—A factory or workshop deemed to be structurally defective may be dealt with by a Court of Summary Jurisdiction on *ex parte* application by an Inspector. So far as such defects and action arise from possible accident on the occurrence of fire, they are dealt with at length in the next chapter. Many structures of a more or less temporary character give rise to serious and even fatal falls, but it is very rarely that the main fabric of a factory or workshop is allowed to get into a dangerous condition.

Perhaps the most serious results, so far as accident is concerned, arise from the absence of vat and pan, and staging safe-guarding in trades not under Special Rules. Surrounding rail protections or covers, or railed cross gangways, can easily be supplied and maintained at the former, but the latter present great practical difficulties.

In shipbuilding, for instance, certain gangways and hatches are utilised as passages for the common traffic of both piece and time workers, and the safe-construction and maintenance of these, and of all necessary rails and covers for safety, should be the special care of a person duly appointed by the factory occupier. On the other hand, piece-workers individually and in gangs are, in practice, solely responsible for the safe-erection and use of their own necessary staging, but failure to observe care in this respect is not infrequent, and often entails injury to themselves and others.

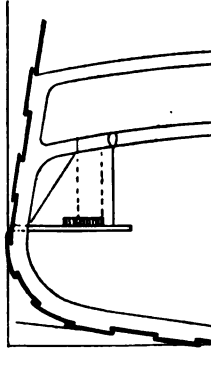


FIG. 120.

In 1898 no less than forty-seven deaths and 1592 injuries were sustained in shipyards alone from falls of persons, while a considerably larger number of non-fatal accidents were likewise caused by falls of material, staging, and blows from falling tools. Fig. 120 illustrates a class of accident which often results in death from fracture of the skull, or, at the least, in permanent incapacity. A plating or riveting gang erect a two, and sometimes one, plank platform, but at intervals in the

vessel's length a deep frame with angled plate stays occurs, and the clear headway is only obtainable for the width of the outside plank, and sometimes less, with the result that accidental contact with the projecting frame or stay is often followed by precipitation into the hold. Some supervision is possible, but workmen have the cure in their own hands.

Under Special Rules.—The safety regulations which have been established since the passing of the Factory Act of 1891 under the powers then conveyed to the Secretary of State, are contained in a series of "Special Rules," and the procedure by which proposals of this kind become binding upon occupiers in dangerous trades is detailed in Part III. The greater part of the regulations of this nature already in force relate to precautions for the prevention of illness or injury to health. In the explosive, chemical, and aerated water industries, however, Special Rules providing amongst other things for safeguards against accident or danger to life and limb have been established. The full text of these Rules is given in Part III., and their nature and general application are here considered under *Contact with Dangerous Material, Lighting, Space, Fencing of Vats and Pans, Ventilation and Respirators, Masks, Gauntlets, and Screens.*

Contact with Dangerous Material.—In the manufacture of di-nitro-benzole explosives, and in the grinding of chlorate of potash dangerous dust is prevented from accumulating on the workers' ordinary clothing by the use of overalls, which, for safety, have to be brushed before each cessation of work, and kept in a cleanly state by weekly washing; while lavatory, and in chlorate mills, bath provision ready for immediate use, is required for all such workers. The handling of di-nitro-benzole

must be done with india-rubber gloves, clean rags, or in filling cartridges, by scoops, and only a long wooden instrument is permitted for breaking this dangerous material by hand. In alkali works the projection of small portions of soda or potash from charged caustic pots is the cause of serious injury to the skin, and particularly to the eyes of workers who may be struck. The only remedy in such cases is the immediate application of a solvent and diluting fluid, such as clean water. For this purpose charged syringes or wash-bottles of the ordinary laboratory type—one for every four caustic pots—must be kept in covered boxes ready for immediate use, and similar appliances are authorised in any other chemical department where the same risk prevails.

Such provisions may also be of much service in soap, paper, and other factories in which caustic substances are used in large quantities and may give rise to accident.

In the chlorate mills of chemical works contact between escaping machinery oils and the ground crystals must be avoided by the use of a plastic or solidified lubricant, such as tallow.

Lighting.—The dangers from inefficient illumination of factory premises have been referred to in Chapter VI. in treating of the causes of factory accident.

They are specially noticeable in chemical and bi-chromate works, and thorough lighting in these at all dangerous places must be maintained under the Special Rules. The sheds and vat rooms of such works are usually subject to rapid deterioration from chemical action, and roof glazing is seldom attempted, with the result that, even in the daytime, very dark places have to be entered.

In many other classes of works, however, it is common to find a dangerous opening or vessel of liquid in a dark

place which is left unilluminated on the plea that only one or two men occasionally have to approach, but the accident records show that frequent serious and fatal injuries are sustained by individual workers in remote and badly lit portions of works, and the employer's civil liability is now so onerous that no place of doubtful safety in this respect should be neglected.

Space.—In arranging vats, pots, pans, and similar structures containing dangerous material, in chemical and bichromate works, care should be taken to give a clear space round such, or, where junctions exist, to place an effective barrier thereat, and so prevent the use of the place as a passage by mounting upon the pan edge with resulting danger. The practice of allowing rubbish to accumulate round alkali and other pots leads to the rapid filling up of an originally safe and clear passage and should be studiously avoided.

The crowding of machinery and structures generally is the cause of a good many accidents, and where this practice is followed the safe-guarding provisions must be of the more absolute character, as there is seldom room in such circumstances for effective retired rail and similar protection.

Fencing of Vats and Pans.—In the chemical and bichromate industries a special difficulty arises from the rapid deterioration of rail and other fences through chemical action and rough usage, and every effort should be made, especially in new, uncovered pots, pans, and vats, to fulfil the Special Rules requirement that such structures should be at least 3 feet in height above the ground or platform, or other standing or working level. Where existing structures of this kind are less than 3 feet above the working level, or where such a height in any new structure is proved to be impractic-

able, secure fencing must be provided for safety. No such fencing in the above trades or in any others with uncovered vats of liquid material, dangerous from its chemical composition or high temperature, should be less than 3 feet above the standing level, and the outer edges of alkali and other dangerous pots should be rounded off to prevent the use of them for a footing.

The projection of dangerous material, especially of a caustic nature, can be greatly reduced by the provision recommended in the Rules of dome-shaped, balanced lids, which can be readily raised when necessary.

The "boshes" or metal-cooling tanks sunk in the floors of foundries, and iron and steel and other works, give rise to frequent scalding accident, and the rail protection which affords the necessary opening for insertion of material or tools should be made very substantial and be repaired whenever necessary.

The Special Rules require all open or unfenced vats and pans, containing liquid of a dangerous nature in chemical and bichromate works, to have any planks or gangways crossing them securely fenced, and such provision should be made in the same circumstances in all paint, colour, oil, paper, soap, starch, and other factories where vats are common.

In bichromate works, where it is impracticable to observe the 3 foot standing level limit in the case of gangways not exceeding 27 inches in width, and suspended from the lip or edge of vessels, a minimum clear height of 20 inches from platform to top of vessel is exceptionally permitted by the Special Rules.

Ventilation and Respirators. — "Gassing," or the accidental inhalation of dangerous vapours in chemical works, is a source of accident, with fatal consequences sometimes where speedy rescue is lacking, and the

Special Rules in the three industries already noticed make particular provision against such occurrences.

Mechanical ventilation is prescribed by the Rules in the purifying, grinding, mixing, and cartridge-filling of di-nitro-benzole explosives, while the drying stoves in the same industry must be efficiently ventilated prior to the entry of workers for charging or discharging the same.

In chemical works the Rules require an efficient draught at salt-cake furnaces to prevent the escape of low-level gases, the abstention from opening up Weldon bleaching powder chambers until the minimum amount of chlorine prescribed by the Alkali Act standard is reached, and a record of the tests must be kept in a special register. When unsealed, such chambers must be ventilated during packing operations by means of open doors on opposite sides and roof openings, while rescue respirators filled with moist oxide of iron or other suitable absorbent must be kept in accessible places for immediate use in cases of "gassing" by sulphuretted hydrogen or other noxious fumes. Cylinders of compressed oxygen, furnished with suitable mouth-pieces, and kept ready for instant use in convenient situations, are invaluable adjuncts in rescue work.

It is very important that overseers and workmen should have some knowledge of the nature and occurrence of the dangerous gases met with in some factories, and of the appropriate remedial treatment.

The most unskilled forms of male adult labour are largely utilised in such places under skilled supervision, but even intelligent tradesmen exhibit a striking ignorance of matters closely concerning their safety. In a case investigated by the author, an experienced brick-layer, employed for many years about a chemical work manufacturing bleaching powder, was requested to

repair a hydrochloric acid open-air vessel constructed of stone slabs on a brick foundation, the latter having slightly yielded. On taking out the earthenware cock, some residual acid was spilt upon the ground, and, without the least consciousness of danger, the man took a shovelful of the works waste containing sulphides and spread it on the ground to absorb the acid, with the result that the deadly sulphuretted hydrogen was evolved, which, rising to the workman's breathing level, caused instant collapse and death.

Under the Rules, suitable respirators must be provided for the use of workers in all situations where poisonous gases are likely to be inhaled.

"Gassing" risks are not confined to the chemical works named in the Rules. Gasworks, and the portions of these and of other works devoted to sulphate recovery from ammoniacal liquor, are liable to discharges of sulphuretted hydrogen, a most dangerous gas, of which only a small quantity is required to produce insensibility. Carbonic oxide and carbonic acid also occur thereat. The prescribed absorbent respirators enable some inhalation of oxygen to take place where, from the circumstances, removal of the person from the spot is not immediately possible.

Some gases, such as chlorine, hydrocyanic acid, hydrochloric acid, arsenuiretted hydrogen, and sulphurous anhydride, which are met with about cyanide plants, salt-cake furnaces, condensing towers, and pyrites and other ore-roasting kilns, are so irritating that the presence of a very small quantity is readily detected, and affords warning, which, however, is not always taken. Others, like sulphuretted hydrogen, though distinctly perceptible, are very sudden in their action, while the remaining cases are very insidious.

Distillery and brewery vat attendants have again and again been found suffocated by carbonic acid, and yet in a standing position with the arms resting upon the fermenting vat edge. In such places special roof openings and lower air inlets should be provided to remove the large quantity of heavy gas generated.

A "gassing" accident which may occur in many classes of factory is that due to the inhalation of nitrous oxide, or of the dangerous mixture of oxides in nitric acid fumes. The breaking of an acid carboy in a bleach, print, or other factory, will sometimes give rise to this, and remedial steps are necessary, even where no apparent distress after the accident has been noticed, for violent reactionary symptoms may take place some hours after the poison has entered the system. In acid works the Gay-Lussac towers should be connected at top or bottom to a chimney draught during repairs, and the vitriol chambers should be eased off, opened up to a considerable extent, and left to air for several days before renewals are attempted, as in these operations most serious accidents from "gassing" by the oxides of nitrogen have taken place.

Masks, Gauntlets, and Screens.—The number of accidents from the bursting of aerated water bottles under pressure led to the inclusion of this industry—for the sole purpose of accident prevention—under Special Rules. In 1898 128 injuries, from explosions alone, occurred to workers in this trade, besides sixty-seven others which doubtless embraced a considerable proportion of the serious and painful lacerations which the glass used inflicts. The accidents due to explosions result in the violent projection of sharp pieces of glass, and occasional serious injury to the eyes, face, arms, and hands. These casualties can now be largely avoided

by the suitable placing, as required by the Rules, of machines in relation to each other, the screening of these where necessary, and the provision for the use of all bottlers, wirers, sighters, and labellers of wire-netting face guards, masks, or veils, and, in addition, for bottlers, full-length gauntlets for both arms, and for wirers, sighters, and labellers gauntlets protecting at least half the palm and the space between the thumb and forefinger, the laceration of which is sometimes attended with very serious consequences. Similar provision should also be made for the protection of testers of bottles by compressed air in glass works.

In concluding this notice of special safety precautions under the Statute and under Special Rules it is necessary to emphasise the necessity for conscientiously instructing workers and overseers if the latter provision, especially, is to bear its full fruit. Workers who have been reasonably instructed in their duties under Special Rules in any of the trades included, and who persistently disregard them, can be proceeded against under the Acts, and subjected, on conviction, to salutary penalties. This has already been done to some extent owing to the indifference of individual employees to their own and the common safety.

CHAPTER XIII.

FIRE RISKS AND ACCIDENT.

A FACTORY or workshop, or other industrial premises, may be a source of danger from accident to workers in the event of fire in one or more of the following ways. Adequate provision may not have been made for fire-resisting construction, fire prevention, fire escape, or fire extinction.

By many persons the whole precautions necessary are summed up in the last-mentioned item, and the establishment of a suitably equipped fire-extinguishing brigade, or, more frequently, the existence of a good local fire service and supplementary provisions of a minor character at the works are considered a satisfactory discharge of their obligations.

Thoughtful persons, however, have come to perceive that the first-mentioned items have an equal, if not a first claim upon their attention, and, as the large subject of fire service methods is tolerably familiar to most occupiers, the author proposes in this chapter to deal chiefly with the former matters.

Fire-resisting Construction.—For a considerable time after it was realised in this country that structural provision with the object of preventing fire, or, rather, limiting its range for a reasonable period, was desirable, the practice of architects and builders was to resort to various forms of so-called fireproof flooring and subdivisions in factories and similar industrial premises.

Cast-iron columns and girders, and latterly rolled iron or steel beams, were used, combined with stone, concrete, and other non-combustible materials.

In many such combinations no account even of a merely qualitative nature was taken of the molecular forces of great magnitude brought into play when the arrangement was subjected to high temperature for a considerable time. The result was that whole mill floors of non-combustible material proved in case of fire, time and again, to be anything but fireproof through their deformation by expansion, especially of the exposed metal portions which the fire could reach, not to speak of their inability in such a state to sustain anything like the load imposed upon them.

The resulting damage to property and danger to the public has actually been greater in many cases of fire at premises considered fireproof than it would have been had an interior of ordinary material been entirely "gutted," leaving the walls and gables intact. In the former case these costly portions of a building have been thrown down in the course of a fire, or badly damaged by ill-considered "fireproofing" arrangements, while the possible salvage both of life and goods has been diminished by the destructive effect of such massive and ineffective protection in its fall.

Subdivision also is an important factor in construction for limiting the area of a fire, and vertical partitions should be made capable of withstanding for an hour or two a temperature of 2300° Fahr. Isolating doors need not be constructed of non-combustible material. A thick wooden door shielded from direct contact with flame by sheet metal is often superior to heavy metallic constructions, which are easily deformed and buckled under intense heat.

Ceilings in which ordinary laths are replaced by wire rods or netting, and floors with wood or iron joists properly arranged and wholly covered from the action of flame by a filling in of concrete or other resisting material, will isolate a room or flat which is on fire for a time long enough to permit of extinction. Solid wood floors, also, when 6" to 7" thick, and with cemented joints, are excellent fire-resisting constructions, but their cost is usually prohibitive.

The qualitative value of such arrangements is now well understood, and serious danger to the walls and other parts of a modern building from the above causes is the result of indifference on the part of the owner or of inefficiency or carelessness on the part of the designer or contractor, or both.

The quantitative value of so-called "fireproofing" of most descriptions has still to be independently certified, and in this connection the work of the British Fire Prevention Committee deserves the attention of all designers, constructors, and occupiers of industrial premises. This Committee, which practically owes its existence to that terrible example of neglect of elementary fire-prevention principles—the Paris Charity Bazaar Fire of 3rd May, 1897—has, under the able guidance of Mr. Edwin O. Sachs, established testing chambers in London, equipped with all necessary appliances for reproducing actual fire conditions, and already valuable quantitative results have been obtained which are duly attested by impartial authorities delegated to watch the experiments. Members can have the use of the chambers for the testing of forms of building construction materials and appliances. A Factories and Workshops section has just been formed, and occupiers becoming members are furnished with

the latest information on fire matters, and have special seasonal cautions and instructions supplied from time to time for their guidance on fire risks.

Fire Prevention.—In manufacturing premises much can be done by good management and by the individual operatives to limit the fire risk, a certain part of which is common to all factories and workshops, while industries have to be differentiated to some extent in considering the special risks.

Apart altogether from the requirements of insurance surveyors as to fixed hydrants, portable water service, and sprinklers, the use of which only begins when a fire has *not* been prevented and operatives know how to handle them, the common industrial risks which can be obviated with care and a little expense may be grouped under *Lighting, Heating, Ventilation, Watching, Power Transmission, Cleaning, Disposal of Waste Material and Storage.*

Lighting.—In factories, workshops, and warehouses, H.M. Inspectors still find portable lamps to some extent in use, particularly in storage premises and in small workshops. The individual risk in the latter case is, pecuniarily, low, but as premises of the kind are usually, in cities, very much crowded, the results may be spread far beyond the original area of the conflagration. Ill constructed and unsuitably placed lamps and gas-fittings, and unscreened low burners should be avoided, and care should be taken to have the gas cut-off for the whole premises in an easily accessible and outside position.

The author has found that the introduction of gas engines in small factories has led in some instances to the cut-off being placed in the engine-room, and, in the case of a fire in the latter, it has been impossible

to shut off the supply or to prevent its renewal when the main pipe within the factory has been injured.

The great advantages and safety of electric light, particularly of the enclosed incandescent film, in industrial work are being increasingly recognised in the provinces owing to the enterprise of municipalities and private supply corporations. In installing the latter, however, conformity to the standard wiring regulations is a *sine qua non* for safety.

Smoking is generally prohibited, but the use of matches in connection therewith and with gas lighting should be looked to, while the lighting and extinction of special gas and electric lamps should be a specially assigned duty.

In all cases where repairs in a factory are proceeding after hours care should be taken that more than *one* person is upon the premises, and the handling of lamps or other illuminating apparatus should be subject to strict supervision. Through bad glazing, fires have also originated by the resulting high temperature due to the focussing of the sun's rays upon combustible material, particularly in textile factories.

Heating.—In hot air and water circulations particular attention should be paid to the danger from overhead flues in the generating apparatus and to the isolation of such parts from joists, flooring, and other non-resisting parts of the premises. The safe construction and use of fire hearths and chimneys, closed and open stoves, skylights and lightning conductors, in relation to the above parts, is now well understood, though, unfortunately, it is often only efficiently carried out by contractors, even when specified, through the careful supervision of the architect or master of works.

The intelligent oversight and instruction of the

factory operatives is also necessary in conjunction with the best structural arrangements for the prevention of fire through the above causes.

Air space is one of the best insulators, and where hot air or steam pipes are carried through combustible divisions, the hole should either be made a good deal larger than the pipes, or be lined with non-combustible material; the pipes should never touch wood or similar work. In the case of steam leads to prime movers considerations of economy will dictate the effective covering of the pipes with non-conducting composition, and greatly reduce the risk referred to. Dust, and particularly textile waste, should not be allowed to accumulate on heating or steam pipes.

Ventilation.—In some cases this is combined with the heating arrangements and is well under control, but adjustable windows and roof openings for egress of smoke when necessary should be provided, and are always available in good natural systems of ventilation. Fire is sometimes unwittingly assisted where originally capable of easy extinction by the openings in floors and hoist wells. The latter are frequently so arranged as to act directly as dangerous air shafts. In every such instance hinged doors, either in one piece or in halves, can be used to cover openings, and can be secured in a vertical position inside the hoist well at each level in readiness for emergencies. Several warehouse fires within the author's experience were converted into total losses through the latter cause, though originally affecting but a small part of the premises.

Watching.—In all well-organised factories some system of watching or patrol is carried out as a preventive measure during the hours when industrial

operations are discontinued. Such duties generally devolve upon the works watchman, and intelligence, character and activity in such a person should always be demanded. Where boiler fires are simply damped down and the watching consists of unchecked periodical patrols of the premises in a prescribed manner, everything depends upon the trustworthiness of the agent. The moral effect of surprise visits is helpful in this connection. In some factories visited by the author, the places at which unusual elevation of temperature is likely to arise are supplied with electric fuses which on melting set a bell ringing in the gate-house till attention is given. In other cases recording control watches or clocks, which can only be operated by non-detachable keys thereat, are distributed over the factory on a system which ensures a thorough periodical patrol in visiting them. The insertion of the key by a watchman at each passing of an individual clock is all that is necessary, and every morning a tape record of the number and order, and of the times of the visits to within fifteen minutes is obtainable as a check. In very large factories, with more than one watchman, a system of fire calls in connection with such patrols is also practicable.

Power Transmission.—In fitting up the prime mover and mill-gearing of a factory or in rearranging these, fire-resisting partitions are pierced for the insertion of wall boxes and pedestals. These are frequently not designed to prevent the communication of fire, and give a clear through and through opening. Isolation in this part may be obtained in large wall boxes by providing internal flanges (Fig. 121) on one side, to which metal plates can be bolted, leaving only sufficient clearance for the shaft. Small bearings of

this description (Fig. 122) can easily be cast with one side solid and a small opening for the shafting. In the case of mills driven by vertical shafting and toothed gearing these portions are best contained in a separate walled tower with fire-resisting doors at each level of access to prevent the communication of fire

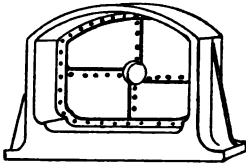


FIG. 121.

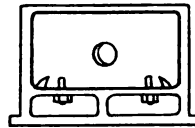


FIG. 122.

to each flat. At troublesome bearings the electric fuse indicator already referred to is useful for calling attention to overheating and its resulting dangers. In some factories slovenly, wasteful and dangerous methods are still in use for collecting drip oil from engines, machines and shaft bearings. In such cases oil is allowed to fall upon the floor, which it quickly permeates and renders highly inflammable. Then, as an afterthought, waste, rags, or sawdust are laid down to absorb the drip. All such practices are extremely dangerous, and pedestals can be had, designed with proper oil catchers, while tin trays can easily be adapted to any journal for the same purpose.

Cleaning.—The systematic sweeping up of factory and workshop floors is an important preventative. In some industries the cuttings and waste material which litter the floors and are distributed over the benches, walls and machines, the escaped oil, used-up rags, and cotton waste are singly and collectively of such a nature that the least thoughtlessness or carelessness will preci-

pitate a serious conflagration. The cure of this is entirely in the hands of overseers and operatives.

Disposal of Waste Material.—Closely connected with the subject of cleanliness is that of the disposal of refuse. If, as in some cases, oil-soaked sawdust, rags, waste and the various cuttings of industrial material are swept into a heap in a corner of the room, or are mixed at all in a common outside receptacle, certain provision is being made for fire when other circumstances are favourable. No waste materials of these descriptions should be allowed to accumulate within the factory, and those which have absorbed any oil should not be mixed in any way with the dry waste products.

Storage of combustible finished materials, of dust, waste, rubbish, paint, naphtha, and inflammable oils, not to speak of more dangerous substances, should be carried out with great care, and access to the isolated premises used for such purposes should be strictly limited to the persons immediately concerned.

Special Trade Risks.—The preventive precautions just detailed which should be taken in all industrial premises in view of fire risk, necessarily bear more particularly on some trades than others, and in concluding the subject of Fire Prevention some notice may be taken of particular trade dangers in this respect.

Textile Factories number 9951. Cotton mills, in spite of the attention paid to construction and to all the above preventive measures, enjoy the unenviable position of being most dangerous. Disastrous fires in cotton, wool, worsted, jute, flax, rope, and other textile industries might be even more frequent were it not that the diligent collection of waste is necessary both

for economy of material and for efficient working of the machinery. The latter and the floors, ceilings and walls are always covered more or less with fine fluff or heavier fibre and dust, and a fire will sweep across a room fed by such waste material, if sufficiently abundant, with marvellous rapidity. Spontaneous combustion, which, in some phases, is yet wrapped in mystery, has to be reckoned with in such works and all preventive measures require to be adopted to their fullest extent.

Non-Textile Factories.—Amongst the 71,259 occupiers in this—the principal section of manufacturing industry—special fire risk is naturally determined by the character of the material operated upon, and wood, paper and cardboard productions take the first place in connection with whatever class of premises they may be included. These are chiefly found in sawmills, firewood, carpenters, cabinet, paper and millboard factories, common and fancy box works, and the stationery trades, including letterpress printers, machine rulers, bookbinders, etc., but also in subsidiary processes in many other trades.

In sawmill and other wood-working premises special attention must be paid to storage of material, cleanliness, safe lighting, and the efficient collection and disposal of shavings and sawdust, and additionally, in the case of carpenters, and cabinetmakers and the other industries mentioned, proper construction and safe position for that venerable fireraiser, the gluepot. In all these trades attempts to smoke contrary to regulations, the unauthorised use of matches by operatives, or careless distribution of furnace cinders should be severely punished, and electric light carefully installed is a considerable aid to prevention of fire.

In steel mills, foundries, engineering, shipbuilding, and other metal works, operations are largely conducted on the ground level, and the joiners and pattern shops, the sawmills and stores are the chief risks. The application of steel has recently made great progress in the construction of metal-working factories, and with the absence of wood in roofing, galleries, and bench supports and the removal of waste and oil, the risk can be very largely confined to the parts named. A slight fire in such premises may not do much apparent damage, or practically none, to the building, but the serious effects in the deformation by heat of very expensive machinery must be kept in view.

Factories in which food and drink are prepared form a class by themselves. Bakeries, breweries, distilleries, preserve and provision works and sugar refineries necessarily utilise heat and fire in a more extensive, open and dangerous manner than other trades, and are subject in addition to explosion of dangerous gases and spontaneous combustion.

Stored products also form a considerable warehouse risk in connection with these factories and entail much attention to isolation and subdivision.

Oil, colour, paint, varnish, leather and chemical factories are particularly dangerous from the fact that, apart from ordinary considerations, accidental spilling or contact or mixing of different materials may lead either to direct combustion or previous chemical action or explosion. Subdivision of buildings and the conducting of the various processes in separate premises is necessary in most works of this description.

Warehouses.—In such premises the precautions already referred to regarding construction, fire-resisting

divisions and doors, hoist wells, machinery and prime mover arrangements, and the isolation of the floors and control of draught are essential for safety, while jute, cotton and other materials require periodical inspection to avoid the risk of spontaneous combustion.

Workshops.—In this class of industrial premises the risks due to power are absent, but nearly all the trades already enumerated are conducted on the small scale in such places, the individual occupiers of which number 85,910 throughout the United Kingdom. Wearing apparel and food, however, account for no less than 48,902 and 9688 respectively of such premises. In the former, cleanliness, the disposal of rubbish outside the building, the protection of naked gas and other lights, the safe construction and working of close and open stoves, and the keeping of passages clear of empty packing cases containing straw and paper are the chief preventive requirements. In the latter workshops, especially the 7970 devoted to the preparation of bread, biscuits, and confectionery, the use of heat and fire is extensive, and well-designed construction and arrangements of joists, floors, ovens, stoves, hot plates, etc., is essential in addition to the details of management already referred to.

Fire Escape.—Various building regulations and bye-laws administered by the local authorities of the larger burghs provide more or less for some of the precautions in industrial premises already detailed. Adequate provision for escape in case of fire is also insisted upon in the case of large public buildings, but, on the whole, the safe-guarding of factories and workshops in the matter of fire escape has been mostly accomplished within the last seven years, during which the provisions of the Factory Acts of 1891 and 1895 on the subject

have been largely put in operation by the combined efforts of Her Majesty's Inspectors, and Burgh Surveyors and Firemasters. In Chapter III. these safety regulations, which make some distinction between old and new buildings, have been summarised, and in Chapter XVI. the text of the law on the subject is given. The practical bearing of the statutory provision against accidents from fire may be discussed under the following heads: *Door Fastenings, New and Old Premises, Portable Escapes.*

Door Fastenings.—To avoid the superintendence necessary to secure the confinement of operatives to their own tasks and departments and to the premises, it has been the custom of some occupiers to lock or fasten the doors of rooms and factory entrances from the outside during working hours, and in some cases during meal times also.

The practice, always a dangerous one, is particularly so when workers at meals, without overseers or even the presence of such on the premises, are locked into rooms or premises, and by the Act of 1895 it is entirely prohibited. In no factory or workshop, while any person is within for employment or meals, must the external doors or the door of any room containing such a person be locked, bolted, or fastened in such a manner as not to be easily opened from the inside.

New and Old Premises.—The necessity in view of panic, for all exit doors in places of public resort being made to open outwards, has long been recognised, and the provision has been applied to the bulk of factories and a large number of the workshops by the Act of 1895. In all such premises, erected after 1st January, 1896, it was enacted that the doors of each room in which more than ten persons are employed must, except in the case of sliding doors, be constructed so as to open outwards.

Such a provision may well be kept in view by owners and architects in connection with the design and erection of all new buildings for industrial purposes, for, though the Statute limits its application to rooms containing more than ten persons, Her Majesty's Inspectors frequently find premises, the cubic space of which is sufficient under the Factory Acts for a greater number, alternately exempted and brought under the clause according to the requirements of the tenant. In arranging rooms of a capacity of 2750 cubic feet or over, sliding or outward-opening doors should always be specified, otherwise, unless the defect be remedied, the structure can only be used for the employment of a number not exceeding ten persons.

Under the Acts of 1891 and 1895 every factory constructed since 1st January, 1892, and every workshop completed since 1st January, 1896, and in which more than forty persons are employed, must be furnished with a certificate from the sanitary authority of the district (in London the County Council) that the premises are provided on the storeys above the ground floor with such means of escape in case of fire for the persons employed therein as can be reasonably required under the circumstances of each case. It is the duty of the sanitary authority to make the necessary examination, and, if satisfied, to grant the certificate, and premises not so furnished are deemed not to be kept in conformity with the principal Act.

For the same purposes the sanitary authority is also empowered, under the Factory Acts of 1891 and 1895, to deal with all factories and workshops employing more than forty persons and erected before 1st January, 1892, and 1st January, 1896, respectively.

In connection with these older premises provision

is made for arbitration in case of dispute, and the owner is held liable in the matter, though the occupier of such dangerous premises may be called upon at the discretion of the Court of Summary Jurisdiction, after hearing parties, to share the expense of complying with the requirement. It should be noted that the object of the Statute is to obtain every facility for the escape of workpeople on the discovery of fire, and is in no way met by the equipment for that purpose of a fire brigade, which is only available at a later period.

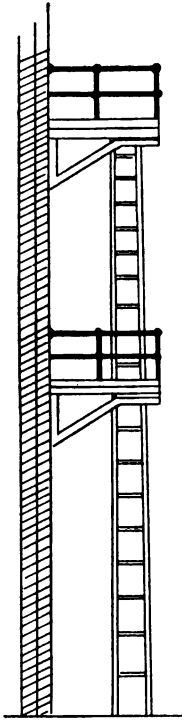


FIG. 123.

New premises then may not be used at all if lacking a certificate of safety, and old premises must be brought into conformity. The practical solution of the matter is embodied in the answer to the question, "What means of escape in case of fire for persons employed above the ground floor can reasonably be required?" In the author's opinion every endeavour should be made to secure provision of a *fixed* nature, and wherever possible it should be an integral part of the building. The latter provision can invariably be made in the plans of a new factory or workshop if the requirements of the law are kept in view and the assistance of Surveyors and Firemasters is called in—which unfortunately is not always the case. It should consist in obtaining alternative exits at each end of each storey of a building. It is practically impossible that *both* exits could be simultaneously burned or rendered im-

passable by smoke, and the construction of the necessary stairs and passages of well-arranged fire-resisting materials will, in addition, greatly assist the access for fire extinction. A tower or internal staircase at each end of the building, with landings and doors opening thereon at each flat, meets all the requirements in the most satisfactory manner.

In new factories and workshops, however, where such provision is an afterthought, and in old premises, alternative exits have to be sought in other ways. Sometimes when the building stands alone and has one such staircase or a central one, stone or metal balconies and railed ladder, or spiral steps of the form in Figs. 123 and 124, can be erected at the extreme end of the building. In cases where the gables of the premises are abutting on other



FIG. 124.

buildings alternative escape provision has to be sought by placing one or more of the metal balconies referred to along the most suitable side or portion thereof of the building at each storey, and connecting the former by ladders or stairs as in Figs. 123 and 124. The access to the escape in event of the works staircase being blocked is obtained by making one or more windows, according to the size of the flat, to open thereon. Care should be taken not to place the descending ladder or stair in front of windows, and to afford the escaping persons all the shelter of the solid and fire-resisting portion of the building. Such fixed external provision, if carried to the top of the building, is of the greatest service for access to roof hydrants in large factories when the fire has cut off the usual internal means of approach.

Though the Statute limits special escape provision to premises in which more than forty persons are employed, there are certain of the trade fire risks already discussed which careful occupiers will seek to minimise, in regard to safety of life and limb, by dealing similarly with the upper floors.

In a varnish factory, for instance, employing only thirty-eight persons, the floors and benches are stored with material and are soon saturated with inflammable fluid, and though only half a dozen persons may be found in one large room with a single end-exit, death and serious injury have resulted in the case of a rapidly spreading fire originating near the sole source of escape and rendering it impassable.

In some cases, particularly of small factories and of workshops, crowded together in our large cities, all the means of escape already described are impracticable. It is still possible in many such instances to provide

an alternative exit by fire-resisting gangways leading from the room or flat windows to another portion of the same building, or across premises of lower elevation to windows or doors permitting access to these, but such provision is really of a make-shift character, and sometimes hedged about with questions of right of way and of ensuring that access to the place of safety is always maintainable. In wearing apparel workrooms, connected as they often are by a single narrow wooden stair with large retail salesshops with considerable fire risk, the latter provision has proved very useful, as the dangerous smoke from a really trifling fire will fill the staircase in a moment or two.

Portable Escapes.—When all other methods of securing fixed fire-escape provision have been demonstrated to be impossible in the circumstances of the case—and not till then—the question of providing one or more portable fire escapes falls to be considered. By every one of the arrangements already described workers can get away from the burning room and, in all but a few cases of the last-described arrangement, escape from the entire premises is certain. Except where the only clear wall space is towards a busy thoroughfare, there is scarcely any situation in which a portable escape can be effectively utilised which cannot be equally served by permanent and fixed plant, but, particularly in connection with old premises, occupiers now and again show a preference for the external safety auxiliary in the form of portable escapes, though the cost may be equal to if not greater than the other, and its working necessitates some delay at a crisis.

Where a local authority has deemed that structural and fixed external methods of escape are impracticable, or where the factory or workshop does not employ

more than forty persons, and an Inspector of Factories satisfies a Court of Summary Jurisdiction that movable escape provision is necessary for the safety of workers, the occupier of the factory or workshop may, under the Act of 1895, be ordered by the Court to provide movable fire escapes sufficient for that purpose. This power, however, is rarely exercised, as expert opinion is entirely in favour of the permanent forms of escape.

Fire Extinction.—As already stated, it is not intended in this work to describe obligations and methods of fulfilling them other than those which fall upon the occupiers and owners of industrial premises under the Factory Acts, but in concluding this account of Fire Risks in relation to accidents it is desirable to emphasise the great efficiency which the sprinkler system of fire extinction has attained, either as automatic extinguishers actuated by a fusible plug on dangerous increase of temperature, or as hand-controlled drenchers which interpose a sheet of water in the path of flames likely to pass through doors or windows from one building or room to another. The life-saving methods of fire brigades by ladders of rope and other materials, telescoping movable escapes, parachutes, bag shoots, jumping sheets and life lines are well known, but are generally of little use unless in skilled hands. Where a large factory has its own brigade, which is kept in training by drills and surprise calls, all the portable life-saving methods enumerated might be quickly at the service of persons in danger, but otherwise they can only be depended upon as a last resort and can in no way take the place of the permanent and constantly accessible means of escape required by the Statute.

CHAPTER XIV.

FIRST AID.

The scope for first aid.—The primary aim of all thoughtful employers of labour in factories will be to prevent, so far as possible, all loss and pain to operatives from accident. The major portion of this work has been devoted to an account of factory casualties, and the discussion and illustration of the practical methods for preventing their occurrence have been concluded with the section in the last chapter on Fire Risks.

Industrial accident was, for a considerable time after the commencement of factory legislation, looked upon largely as the inevitable tribute of labour to the factory system of production.

It was the belief that *some* at least of the injuries so received were preventable, which led to the introduction of safeguarding and accident notification clauses into later Factory Acts. That belief has been strengthened by a lengthy experience, and the progress which has been made in the adoption of preventive measures is much greater than the accident returns would lead one to suppose.

As we have seen, the casualty total from factories has been greatly and increasingly augmented by the inclusion since 1st January, 1896, of the minor non-fatal accidents, which have always occurred but have only been reportable during the last four years, and the addition to factories proper of the following dangerous em-

poyments, amongst others, about docks, wharves, quays, warehouses, and building construction and repair. Also the steady increase in the number of manufacturing establishments and the general improvement in accident reporting have contributed to swell the returns.

From the latest statistics of employment in Railway Service and about Civil Engineering Works, Mines, Quarries, Factories, and Workshops, it is found that out of an annual total of 92,763 reported accidents, the injuries which were non-fatal numbered 89,898, and, of the latter in 1898, no less than 56,835 occurred in premises which are reckoned for various purposes to be factories or workshops under the Factory Acts.

There is, therefore, in industrial pursuits—and specially in factories—apart from the daily and unnumbered casualties of the home, the street, the highway, and the field, great scope for preventive and alleviating measures.

A number of the above injuries, and of the 725 deaths which happened in factories in addition, are in no way preventable by the exercise of care and forethought by the employer and, in some cases, by the operative, and the question arises as to what practical and immediate help can be afforded to sufferers from accident.

The answer to this is found in the work accomplished by trained Ambulance Corps and by individuals possessing a qualification for the rendering of first aid to injured persons.

Its Educational value.—It is the custom in some of our large factories and other industrial establishments to give special attention to this matter by training Corps, establishing a dépôt of requisites, and publishing the names of the persons capable of rendering assistance in each department.

The great bulk of factories, however, are without any organised system of first aid, and many do not possess a single individual qualified to render such services. The awakening of interest in this matter amongst work-people is largely a question of its importance being thoroughly appreciated by some person in authority who is willing to give time and trouble to its advancement.

Ambulance training, apart from its primary humanitarian value on the occurrence of accident, is of special service in other directions.

It is a very useful factor in the development of a workman's intelligence. Nothing has impressed the author more during some years of engineering practice and movement amongst large numbers of industrial operatives of all ages and trades, than the absence of the ability to accurately observe what is taking place before them or to draw the correct conclusions therefrom.

Whether such a defect can be traced to the factory system of production or not, the average journeyman tradesman is remarkably ignorant of cause and effect in things which daily transpire around him and often intimately concern his own tasks.

The result is painfully illustrated in many accidents, some of which have been cited in Chapter VI., arising out of such ignorance and detachment.

Quickness of thought, perception and judgment, and the resulting readiness of resource, are the cope-stone of that solidity and endurance which are the acknowledged characteristics of the British workman, but without the former it is really doubtful if his supremacy, which now involves no mean adaptive faculty, can be maintained. The field for our manufactures is no longer the world, and a defect of this kind has a far-reaching effect upon the worker, his task, and his trade.

Some of this isolation doubtless springs from the great extent to which division of labour is now carried, and the individual loss of interest in the work as a whole which ensues.

On the other hand, part of it is undoubtedly caused by a failure to foster any co-operative movement out of hours amongst workmen, and to secure the helpful and stimulating effects of such contact with their works superiors.

After all, only a small proportion of the skilled tradesmen of the country participate in the benefits of technical education, and very few do so unless during the period of apprenticeship, while it is the rank and file of the operatives who give the work its stamp. It is just here that the secondary social and educative benefits of ambulance training are felt.

In such meetings the faculty of observation, so apt to be untrained or neglected in workmen, is drawn out. They are taught to grasp all the details of an incident or circumstance, to determine the best course of action, and to act upon this with firm resolve where the hesitation of an untrained person might be worse than useless. Lastly, but not least, they cultivate the habit of implicit obedience to orders, a virtue not too common for such aid to be despised.

Necessity for training.—It does not require a great deal of knowledge to qualify for rendering first aid to the persons wounded in the course of factory employment, but the knowledge must always be combined with thorough drill in the methods of putting it into practice and a distinct realisation of its limitations.

Rightly used such ability in an operative is often of the greatest use to both the injured person and the Surgeon.

Careful and skilled handling of injured parts saves the sufferers unnecessary pain, and in the case of fractures and other accidents avoids further injury.

A single instance may be given of the presence of mind which results from the knowledge of a few simple matters and of the appropriate first aid.

At the meal time in one of our large factories a workman, partaking of food in the same room as a considerable number of his fellows, accidentally dropped his open clasp knife and, in attempting to catch it by closing his legs, the point of the blade penetrated his trousers and severed the main artery of the thigh. The resulting flow of blood was so alarming that, with one exception, the whole assembly rose and fled. The man who remained had received instruction in first aid and at once placed his finger on the wound and checked the bleeding effectively until a Surgeon could be obtained. But for this timely assistance the injured person would probably have bled to death. It is neither possible nor necessary in all factories to establish an Ambulance Corps, but the possession by one or more of the operatives of the required skill should be encouraged in every case. The author has found more or less complete outfits of first-aid appliances in a number of works, but in some of these care had not been taken to ensure trained service, and no person, actually in the employment, could effectively utilise the apparatus. Recently a shipyard labourer had one of his legs almost torn off by a hawser at the fitting-out dock, and although he was at once taken to the hospital fatal consequences ensued, owing to his companion having fastened splints round the profusely bleeding limb instead of improvising a tourniquet. Loss of blood from accidental cutting or laceration,

in factories and other places where machinery is used, is one of the commonest cases met with on the proper or improper treatment of which, before the arrival of a skilled Surgeon, much may depend.

Facilities for training.—All the necessary equipment can easily be obtained at the courses of lectures, and of practical instruction and examination at centres all over the country, given under the auspices of the St. John Ambulance Association and similar societies.

This body, founded in 1878, has amongst its objects the following :—

- (1) The instruction of persons in rendering first aid in case of accident or of sudden illness, and the transport of the sick and injured.
- (2) The manufacture and distribution by sale or presentation of ambulance material and the formation of ambulance depôts in factories and other centres of industry and traffic.
- (3) The organisation of Ambulance and Invalid Transport Corps.

The object of the Association is not to rival but to aid the medical man, and the authorised courses of instruction are framed by the Medical Committee of the Ambulance Department with the view of qualifying the pupil to adopt such measures as may be advantageous pending the Surgeon's arrival.

The first-aid certificates granted after examination are awarded on the distinct understanding that the holders thereof render aid to the sick or wounded *only* until qualified medical services can be obtained.

Grants in aid are made in a few necessitous cases by the Association, but most classes can be made self-supporting. Many of the County Council Technical Instruction Committees organise such classes and sub-

sidise others, while efficient instruction in the principles underlying the practical work is recognised as qualifying for pecuniary assistance by the Science and Art Department.

Nature of the Training.—The course of instruction consists of five lectures, conducted in every case by a qualified medical practitioner and accompanied by practical demonstrations.

In the first general principles are enunciated and expounded with regard to the structure and functions of the human body. The second treats of hæmorrhage or bleeding, and in it an endeavour is made to set forth clearly the directions of the main blood vessels of the body, and give instructions for the proper application of pressure to arrest the escape of blood.

The third lecture deals with fractures or broken bones, giving such information as may enable the student to recognise the symptoms of such and to distinguish between fractures and dislocations. In the fourth lecture reference is made to dangers arising from accidents, such as insensibilities and those caused by strangulation, suffocation, drowning, and choking, and the effects of, and simple remedies for burns and scalds, poisoning internally or by wounds, frost bite, sunstroke and similar open-air risks.

The fifth lecture gives detailed instruction on the safe movement of the sick and injured, either by hand or by ordinary or improvised stretchers.

At the end of this course of lectures an examination by a separate medical man is held, and to those who succeed in passing this certificates of success are awarded.

In order to prove that the knowledge and skill once acquired has not been forgotten the highest award of

the association—the first-aid medallion—can only be obtained by certificated pupils who have twice successfully undergone re-examination with intervals of not less than twelve months between each. This qualifying badge may well be set before operatives as the goal of attainment.

Special applications of the Training.—In connection with employment in Ship and Boat Building Factories and the fitting out of vessels at the docks and quays, inside or outside thereof, as well as occupation about river sides and basins, a special endeavour should be made to have a few persons thoroughly trained in the manner of performing artificial respiration, of which Dr. Sylvester's method is considered the best.

It can be performed by one person alone, is very simple, and does not require any great amount of skill to practice it. In addition to summoning medical aid at once, it should be resorted to *instantly* in all cases of apparent death by drowning, strangulation by accident, suffocation by inhaling the fumes of charcoal fires, burning lime, brick and earthenware kilns, or noxious gases in chemical factories and other premises. The attempt to revive life by inducing the restoration of natural respiration should be invariably persevered in for some time. Remarkable instances are upon record of successful results attending lengthened and persistent efforts of this kind in cases apparently hopeless to the ordinary observer.

The application of Sylvester's method to cases of apparent death, or severe injury from electric shock, may not be generally known, but it has been clearly demonstrated to be the only satisfactory method of dealing with suspended animation from this cause. As already indicated in detail, when dealing with prime

mover safeguards, all persons engaged in the generation and distribution of electricity, whether in stations specially devoted to the purpose, or as auxiliary processes in ordinary factories, should be made fully aware of the dangerous parts of the machinery, cables, and connections.

At the same time *every* person engaged in such operations or likely to be near the plant in the exercise of his vocation, should be instructed in rescue and resuscitation methods.

Death in many cases of electric shock is only apparent, and prompt treatment may result in the restoration of animation.

The preliminary danger to the rescuer in removing the injured person for treatment should not be forgotten.

Where the accident has been caused by contact with a naked or faulty high-pressure conductor or cable, the injured person frequently retains a firm grasp of the latter. In such circumstances the seizing of a limb, or even of the garments, has communicated dangerous and even fatal shock, or caused dangerous fall to the rescuer; for the natural moisture of the clothing, particularly under the armpits, renders it a good conductor of high-pressure electricity.

For this operation the india-rubber gloves, recommended when treating of work about generators, are perfectly safe, or an insulator may be improvised of rags or padded garments when pulling the victim away from the live conductor or machinery which he has gripped.

While awaiting medical assistance the Sylvester method for inducing respiration should be methodically and deliberately carried out, and when an assistant is

available the tongue should be forcibly and regularly drawn out during the act of respiration, or raising of the arms above the head, and allowed to recede when the arms are brought down upon the chest. No attempt should be made in any case of apparent death to induce circulation and warmth until the efforts to restore natural breathing have been successful.

In the cases of "gassing" at chemical and other works referred to in Chapter XII., first aid in the above direction, and in the handling of compressed oxygen cylinders, may be absolutely necessary, and the ability to perform the requisite simple movements with accuracy should be encouraged for all workers.

PART III.

TEXT OF THE LAW ON ACCIDENT AND
SAFETY IN FACTORIES.

INTRODUCTION.

The Factory Acts.—The first Factory Act was passed nearly a hundred years ago—in 1802—but the fifth Act, ^{The Factory Acts, 1802 to 1895.} that of 1831, limited in its application to the Cotton industry, was virtually the first which was, even to a small extent, carried out.

It was followed in 1833 by an Act appointing for the first time four Factory Inspectors, increasing the restrictions upon hours of labour, and bringing under their scope other textile occupations, namely, the spinning and weaving of wool, worsted, hemp, flax, tow, and silk. This Statute, however, like those which preceded it, did not require any fencing of machinery.

Eleven years later the consolidating Act of 1844, applicable only to the same textile industries, was passed, and in it accident and safety regulations were laid down for the first time on lines which were followed in the subsequent Acts.

The course of factory legislation during the next quarter of a century was chiefly that of increasing the restrictions placed upon the hours of labour of women, young persons, and children, and gradually extending to non-textile

industries the protection hitherto confined to textile operatives.

Print Works were added by the Act of 1845, Bleaching and Dyeing Works in 1860, Lace Manufactories in 1861, Bakehouses were brought partially under regulation in 1863, and Earthenware, Percussion Cap, Lucifer Match, Cartridge, Paper-staining, and Fustian-cutting Works in 1864. In the Factory Extension Act of 1867 a great advance was made in the scope of the Acts, a large number of important classes of works being included in the word "Factory" for the first time, and brought under modifications of the existing Textile law, namely, all Blast Furnaces, Copper Mills, Iron Mills, Foundries, Paper, Glass, Tobacco, Letterpress Printing, and Book-binding Works, and the manufacture of articles of Metal, India-rubber, and Gutta-percha, by the aid of mechanical power; while every other unnamed industrial establishment employing not less than fifty persons was also declared to be a factory.

The small trades and handicrafts, not otherwise factories and employing less than fifty persons, were dealt with by the Workshops Regulation Act of the same year, which placed them in the category of workshops subject only to the broad general provisions already in force in factories. The carrying out of the workshop law was placed by the Act upon the local authorities, but the failure of the latter to discharge their obligations led to the transference of the duty to the Inspectors of Factories by the Act of 1871.

The numerous Factory Acts were repealed and consolidated in the great Statute of 1878, but subsequent extension, amendment, and repeal in such legislation has resulted in four additional Acts, passed in 1883, 1889, 1891, and 1895 respectively.

A large portion of the existing law on Accident and Safety is contained in the later Statutes, which proceed by way of reference to the principal Act with which they must be collated to be understood, and consolidation is therefore again very necessary.

The Text of the law on the subject of accident and safety in factories, workshops, men's workshops, and in laundries, docks, warehouses, and buildings, brought for such purposes under the Acts in 1895, has in the succeeding chapters been collected for the first time from the Acts of 1878, 1891, and 1895, through which it is distributed. The repealed portions are eliminated and it is made to read as a whole, with marginal references to the contributing sections of the several Statutes, and has also been topically arranged on the following lines :—

Arrangement
of Codified
Law.

In Chapter XV. Factories and Workshops are defined, and the extent to which other premises come under the Act is detailed. The clauses requiring registration of certain premises are then given, and are followed by all the provisions bearing upon Accident Notification, Registration, and Investigation.

Chapter XVI. is devoted to the provisions for the prevention of accident by safeguarding. The necessary definitions are first given, and are followed by the general and special fencing regulations, the powers relating to Special Requirements, and the Special Rules, so far as they refer to accident, which have already been established.

In Chapter XVII. are detailed the preventive provisions relating to safe working and safe construction, and which limit employment of certain persons about machinery, prescribe the position of self-acting machines, give powers to control the use of dangerous

machines and premises, and require adequate means of escape in case of fire.

These portions of the Acts are followed by the clauses fixing the general liability for observance of the Statute upon the occupier of a factory and exceptionally transferring the responsibility to workmen and owners, while the consolidated text of the law on safety and accident is concluded with the clauses restricting fines and fixing minimum penalties in certain cases.

CHAPTER XV.

PREMISES UNDER FACTORY ACTS.

Factories and Workshops.

THE expression "textile factory" in this Act means:— Factory Acts, 1878, Sec. 93.

Any premises wherein or within the close or curtilage 1891, Secs. 31, 38. of which steam, water, or other mechanical power is

used to move or work any machinery employed in preparing, manufacturing, or finishing, or in any process incident to the manufacture of cotton, wool, hair, silk, flax, hemp, jute, tow, china grass, cocoa-nut fibre, or other like material, either separately or mixed together, or mixed with any other material, or any fabric made thereof:

Provided that print works, bleaching and dyeing works, lace warehouses, paper mills, flax scutch mills, rope works, and hat works, shall not be deemed to be textile factories.

The expression "non-textile factory" in this Act means:—

(1) Any works, warehouses, furnaces, mills, foundries, or places named in Part I. of the Fourth Schedule to this Act,

(2) also any premises or places named in Part II. of the said Schedule wherein, or within the close or curtilage or precincts of which, steam, water, or other mechanical power is used in aid of the manufacturing process carried on there,

(3) also any premises wherein, or within the close or

curtilage or precincts of which, any manual labour is exercised by way of trade or for purposes of gain in or incidental to the following purposes, or any of them ; that is to say,

- (a) in or incidental to the making of any article, or part of any article, or
- (b) in or incidental to the altering, repairing, ornamenting, or finishing of any article, or
- (c) in or incidental to the adapting for sale of any article,

and wherein, or within the close or curtilage or precincts of which, steam, water, or other mechanical power, is used in aid of the manufacturing process carried on there.

The expression "factory" in this Act means textile factory and non-textile factory, or either of such descriptions of factories.

The expression "workshop" in this Act means :—

- (1) any premises or places named in Part II. of the Fourth Schedule to this Act, which are not a factory within the meaning of this Act,
- (2) also any premises, room, or place, not being a factory within the meaning of this Act, in which premises, room, or place, or within the close or curtilage or precincts of which premises, any manual labour is exercised by way of trade or for purposes of gain in or incidental to the following purposes or any of them ; that is to say,

- (a) in or incidental to the making of any article or part of any article, or
- (b) in or incidental to the altering, repairing, ornamenting, or finishing of any article, or
- (c) in or incidental to the adapting for sale of any article,

and to which or over which premises, room, or place, the employer of the persons working therein has the right of access or control.

A part of a factory or workshop may for the purposes of this Act be taken to be a separate factory or workshop ; and a room solely used for the purpose of sleeping therein shall not be deemed to form part of the factory or workshop for the purposes of this Act.

Where a place situate within the close, curtilage, or precincts forming a factory or workshop is solely used for some purpose other than the manufacturing process or handicraft carried on in the factory or workshop, such place shall not be deemed to form part of that factory or workshop for the purposes of this Act, but shall, if otherwise it would be a factory or workshop, be deemed to be a separate factory or workshop, and be regulated accordingly.

Any premises or place shall not be excluded from the definition of a factory or workshop by reason only that such premises or place are or is in the open air.

This Act shall not apply to such workshops, other than bakehouses, as are conducted on the system of not employing any child, young person, or woman therein, but save as aforesaid applies to all factories and workshops as before defined, inclusive of factories and workshops belonging to the Crown ; provided that in case of any public emergency a Secretary of State may exempt a factory or workshop belonging to the Crown from this Act to the extent and during the period named by him.

The exercise by any child or young person in any recognised efficient school during a portion of the school hours of any manual labour for the purpose of instructing such child or young person in any art or handicraft shall not be deemed to be an exercise of manual labour for the purpose of gain within the meaning of this Act.

FOURTH SCHEDULE.

List of Factories and Workshops.

PART I.

Non-Textile Factories.

(1) "Print works," that is to say, any premises in which any persons are employed to print figures, patterns, or designs upon any cotton, linen, woollen, worsted, or silken yarn, or upon any woven or felted fabric not being paper ;

(2) "Bleaching and dyeing works," that is to say, any premises in which the processes of bleaching, beetling, dyeing, calendering, finishing, hooking, lapping, and making up and packing any yarn or cloth of any material, or the dressing or finishing of lace, or any one or more of such processes, or any process incidental thereto, are or is carried on ;

(3) "Earthenware works," that is to say, any place in which persons work for hire in making or assisting in making, finishing, or assisting in finishing, earthenware or china of any description, except bricks and tiles, not being ornamental tiles ;

(4) "Lucifer match works," that is to say, any place in which persons work for hire in making lucifer matches, or in mixing the chemical materials for making them, or in any process incidental to making lucifer matches, except the cutting of the wood ;

(5) "Percussion-cap works," that is to say, any place in which persons work for hire in making percussion caps, or in mixing or storing the chemical materials for making them, or in any process incidental to making percussion caps ;

(6) "Cartridge works," that is to say, any place in which persons work for hire in making cartridges, or in any process incidental to making cartridges, except the manufacture of the paper or other material that is used in making the cases of the cartridges ;

(7) "Paper-staining works," that is to say, any place in which persons work for hire in printing a pattern in colours upon sheets of paper, either by blocks applied by hand or by rollers worked by steam, water, or other mechanical power ;

(8) "Fustian-cutting works," that is to say, any place in which persons work for hire in fustian cutting ;

(9) "Blast furnaces," that is to say, any blast furnace or other furnace or premises in or on which the process of smelting or otherwise obtaining any metal from the ores is carried on ;

(10) "Copper mills " ;

(11) "Iron mills," that is to say, any mill, forge, or other premises in or on which any process is carried on for converting iron into malleable iron, steel, or tinplate, or for otherwise making or converting steel ;

(12) "Foundries," that is to say, iron foundries, copper foundries, brass foundries, and other premises or places in which the process of founding or casting any metal is carried on ; except any premises or places in which such process is carried on by not more than five persons and as subsidiary to the repair or completion of some other work ;

(13) "Paper mills," that is to say, any premises in which the manufacture of paper is carried on ;

(14) "Glass works," that is to say, any premises in which the manufacture of glass is carried on ;

(15) "Tobacco factories," that is to say, any premises in which the manufacture of tobacco is carried on ;

(16) "Letterpress printing works," that is to say, any premises in which the process of letterpress printing is carried on ;

(17) "Book-binding works," that is to say, any premises in which the process of book-binding is carried on ;

(18) "Flax scutch mills."

PART II.

Non-Textile Factories and Workshops.

(1) "Hat works," that is to say, any premises in which the manufacture of hats or any process incidental to their manufacture is carried on ;

(2) "Rope works," that is to say, any premises being a ropery, rope walk, or rope work, in which is carried on the laying or twisting or other process of preparing or finishing the lines, twines, cords, or ropes, and in which machinery moved by steam, water, or other mechanical power is not used for drawing or spinning the fibres of flax, hemp, jute, or tow, and which has no internal communication with any buildings or premises joining or forming part of a textile factory, except such communication as is necessary for the transmission of power ;

(3) "Bakehouses," that is to say, any places in which are baked bread, biscuits, or confectionery, from the baking or selling of which a profit is derived ;

(4) "Lace warehouses," that is to say, any premises, room, or place not included in bleaching and dyeing works as herein-before defined, in which persons are employed upon any manufacturing process or handicraft in relation to lace, subsequent to the making of lace upon a lace machine moved by steam, water, or other mechanical power ;

(5) "Shipbuilding yards," that is to say, any premises

in which any ships, boats, or vessels used in navigation are made, finished, or repaired.

(6) "Quarries," that is to say, any place, not being a mine, in which persons work in getting slate, stone, coprolites, or other minerals.

(7) "Pit banks," that is to say, any place above ground adjacent to a shaft of a mine, in which place the employment of women is not regulated by the Coal Mines Regulation Act, 1872, or the Metalliferous Mines Regulation Act, 1872, whether such place does or does not form part of the mine within the meaning of those Acts.

Laundries.

(1) In any laundry carried on by way of trade, or for purpose of gain, the following provisions shall apply:— Factory Act,
1895, Sec. 22.

(iv.) So far as regards sanitary provisions, safety, accidents, the affixing of notices and abstracts, and the matters to be specified in such notices (so far as they apply to laundries), notice of occupation of a factory or workshop, powers of inspectors, fines, and legal proceedings for any failure to comply with the provisions of this section, and education of children, the Factory Acts shall have effect as if every laundry in which steam, water, or other mechanical power is used in aid of the laundry process were a factory, and every other laundry were a workshop; and as if every occupier of a laundry were the occupier of a factory or of a workshop.

(3) Nothing in this section shall apply to any laundry in which the only persons employed are:—

(a) inmates of any prison, reformatory, or industrial school, or other institution for the time being subject to inspection under any Act other than the Factory Acts; or

- (b) inmates of an institution conducted in good faith for religious or charitable purposes ; or
- (c) members of the same family dwelling there, or in which not more than two persons dwelling elsewhere are employed.

Docks, Wharves, Quays, Warehouses, and Buildings.

Factory Act,
1895, Sec. 23.

- (1) The following provisions, namely :—
 - (i.) Section eighty-two of the principal Act.
 - (ii.) The provisions of the Factory Acts with respect to accidents.
 - (iii.) Section sixty-eight of the principal Act with respect to the powers of inspectors.
 - (iv.) Sections eight to twelve of the Act of 1891 with respect to special rules for dangerous employments ; and
 - (v.) The provisions of this Act with respect to the power to make orders as to dangerous machines shall have effect as if :—
 - (a) every dock, wharf, quay, and warehouse, and, so far as relates to the process of loading or unloading therefrom or thereto, all machinery and plant used in that process ; and
 - (b) any premises on which machinery worked by steam, water, or other mechanical power is temporarily used for the purpose of the construction of a building or any structural work in connection with a building,

were included in the word “factory,” and the purpose for which the machinery is used were a manufacturing process, and as if the person who by himself, his agents, or workmen temporarily uses any such machinery for the before-mentioned purpose were the occupier of the said premises ; and for the purpose of the enforcement of

those sections the person having the actual use or occupation of a dock, wharf, quay, or warehouse, or of any premises within the same or forming part thereof, and the person so using any such machinery shall be deemed to be the occupier of a factory.

(2) The provisions of this Act with respect to notice of accidents and the formal investigation of accidents shall have effect as if:—

(a) any building which exceeds thirty feet in height, and which is being constructed or repaired by means of a scaffolding; and

(b) any building which exceeds thirty feet in height, and in which more than twenty persons, not being domestic servants, are employed for wages,

were included in the word “factory,” and as if, in the first case, the employer of the persons engaged in such construction or repair, and, in the second case, the occupier of the building, were the occupier of a factory.

Registration of Factories and Workshops.

Every person shall, within one month after he begins to occupy a factory, serve on the Inspector for the district a written notice containing the name of the factory, the place where it is situate, the address to which he desires his letters to be addressed, the nature of the work, the nature and amount of the moving power therein, and the name of the firm under which the business of the factory is to be carried on, and, in default, shall be liable to a fine not exceeding five pounds.

Section seventy-five of the principal Act (which requires notice to be given of the occupation of a factory) shall apply to a workshop (including any workshop conducted on the system of not employing any child, young

Factory Acts, ;
1878, Sec. 75
1895, Sec. 44
(1).

Factory Act,
1891, Sec. 26
(1).

person, or woman therein) in like manner as it applies to a factory.

ACCIDENT REGULATIONS.

NOTIFICATION OF ACCIDENT.

General.

Factory Act,
1895, Sec. 18.

For section thirty-one of the principal Act the following section shall be substituted, namely :—

(1) Where there occurs in a factory or workshop any accident which either—

(a) causes loss of life to a person employed in the factory or in the workshop ; or

(b) causes to any person employed in the factory or workshop such bodily injury as to prevent him on any one of the three working days next after the occurrence of the accident, from being employed for five hours on his ordinary work, written notice shall forthwith be sent to the inspector for the district.

(2) If the accident causes loss of life, or is produced either by machinery moved by steam, water, or other mechanical power, or through a vat, pan, or other structure filled with hot liquid or molten metal or other substance, or by explosion or escape of gas, steam, or metal, then, unless notice thereof is required by section sixty-three of the Explosives Act, 1875, to be sent to a Government inspector, notice thereof shall forthwith be sent to the certifying surgeon of the district.

(3) The notice shall state the residence of the person killed or injured, and the place to which he has been removed.

(4) If any notice required by this section to be sent

with respect to an accident in a factory or workshop is not so sent, the occupier of the factory or workshop shall be liable to a fine not exceeding five pounds.

(5) If any accident to which this section applies occurs to a person employed in an iron mill or blast furnace, or other factory or workshop, where the occupier is not the actual employer of the person killed or injured, the actual employer shall immediately report the same to the occupier, and in default shall be liable to a fine not exceeding five pounds.

(6) This section shall extend to workshops conducted on the system of not employing any child, young person, or woman therein.

Exception of Domestic Factories and Workshops.

The provisions of this Act which relate—

Factory Act,
1878, Sec. 61.

(5) To the sending notice of accident; shall not apply—

- (a) Where persons are employed at home, that is to say, to a private house, room, or place which, though used as a dwelling, is by reason of the work carried on there a factory or workshop within the meaning of this Act, and in which neither steam, water, nor other mechanical power is used, and in which the only persons employed are members of the same family dwelling there.

Certain injuries to health included for notification purposes.

(3) Written notice of every case of lead, phosphorus, or arsenical poisoning, or anthrax, occurring in a factory or workshop, shall forthwith be sent to the inspector and to the certifying surgeon for the district: and the

Factory Act,
1895, Sec. 29.

provisions of the Factory Acts with respect to accidents shall apply to any such case in like manner as to any such accident as is in those sections mentioned.¹

REGISTRATION OF ACCIDENT.

Factory Act,
1895, Sec. 20.

(1) Every occupier of a factory or workshop shall keep a register of accidents, and shall enter therein every accident occurring in the factory or workshop, of which notice is required by the Factory Acts within one week after the occurrence of the accident, and this register shall be at all times open to inspection by the inspector and by the certifying surgeon for the district.

(2) If any occupier of a factory or workshop makes default in complying with the requirements of this section, he shall be liable on summary conviction to a fine not exceeding ten pounds.

INVESTIGATION OF ACCIDENT.

Factory Act,
1878, Sec. 68.

By Her Majesty's Inspector :—

An inspector under this Act shall for the purpose of the execution of this Act have power to do all or any of the following things ; namely :—

(3) To require the production of the registers, certificates, notices, and documents kept in pursuance of this Act, and to inspect, examine, and copy the same ; and

(4) To make such examination and inquiry as may be necessary to ascertain whether the enactments of this Act are complied with so far as respects any factory or workshop.

(7) To exercise such other powers as may be necessary for carrying this Act into effect.

¹ By Order of the Secretary of State, date 27th March, 1899, cases of mercurial poisoning so arising are likewise reportable.

The occupier of every factory and workshop, his agents and servants, shall furnish the means required by an inspector as necessary for an entry, inspection, examination, inquiry, or the exercise of his powers under this Act in relation to such factory and workshop.

By a Certifying Surgeon :—

Where a certifying surgeon receives, in pursuance of ^{Factory Act, 1878, Sec. 32.} this Act, notice of an accident in a factory or a workshop, he shall with the least possible delay proceed to the factory or workshop and make a full investigation as to the nature and cause of the death or injury caused by that accident, and within the next twenty-four hours send to the inspector a report thereof.

The certifying surgeon, for the purpose only of an investigation under this section, shall have the same powers as an inspector, and shall also have power to enter any room in a building to which the person killed or injured has been removed.

By Special Order of Secretary of State :—

(1) Where it appears to the Secretary of State that ^{Factory Act, 1895, Sec. 21.} a formal investigation of any accident occurring in a factory or workshop, and its causes and circumstances is expedient, the Secretary of State may direct that such an investigation be held, and with respect to any such investigation the provisions of sections forty-five and forty-six of the Coal Mines Regulation Act, 1887, shall have effect, except that references to the said Act, in the said section forty-five, shall be construed as references to the Factory Acts.

(2) This section shall extend to workshops conducted on the system of not employing any child, young person, or woman therein.

By Coroner's Inquest :—

Factory Act,
1891, Sec. 22.

The Fatal Acci-
dents Inquiry
(Scotland) Act,
1895, Secs. 4, 5,
contains a simi-
lar provision.

(3) Where a death has occurred by accident in any factory or workshop, the coroner shall forthwith advise the district inspector under this Act of the time and place of the holding of the inquest, and at such inquest any relative of any person whose death may have been caused by the accident with respect to which the inquest is being held, and any inspector under the principal Act, and the occupier of the factory or workshop in which the accident occurred, and any person appointed by the order in writing of the majority of the workpeople employed in the said factory or workshop shall be at liberty to attend and examine any witness either in person or by his counsel, solicitor, or agent, subject nevertheless to the order of the coroner.

Factory Act,
1895, Sec. 19.

Where a death has occurred by accident in any factory or workshop, the coroner shall adjourn the inquest unless an inspector or some person on behalf of a Secretary of State is present to watch the proceedings, and shall at least four days before holding the adjourned inquest send to the inspector notice in writing of the time and place of holding the adjourned inquest.

Provided that if the accident has not occasioned the death of more than one person, and the coroner has sent to the inspector notice of the time and place of holding the inquest at such time as to reach the inspector not less than twenty-four hours before the time of holding the same, it shall not be imperative on him to adjourn the inquest in pursuance of this section if the majority of the jury think it unnecessary so to adjourn.

CHAPTER XVI.

SAFEGUARDING.

Definitions :—

Child, young person, or woman.

Factory Act,
1878, Sec. 96.

In this Act, unless the context otherwise requires—

The expression “child” means a person under the age of fourteen years.

The expression “young person” means a person of the age of fourteen years and under the age of eighteen years.

The expression “woman” means a woman of eighteen years of age and upwards.

Employment.

A child, young person, or woman who works in a factory or workshop, whether for wages or not, either in a manufacturing process or handicraft, or in cleaning any part of the factory or workshop, used for any manufacturing process or handicraft, or in cleaning or oiling any part of the machinery, or in any other kind of work whatsoever incidental to or connected with the manufacturing process or handicraft, or connected with the article made or otherwise the subject of the manufacturing process or handicraft therein, shall, save as is otherwise provided by this Act, be deemed to be employed therein within the meaning of this Act.

Factory Act,
1878, Sec. 94.

For the purposes of this Act an apprentice shall be deemed to work for hire.

Mill-gearing.

Factory Act,
1878, Sec. 96.

The expression "mill-gearing" comprehends every shaft, whether upright, oblique, or horizontal, and every wheel, drum, or pulley by which the motion of the first moving power is communicated to any machine appertaining to a manufacturing process.

Machinery and Process.

Factory Act,
1891, Sec. 37.

(1) For the purposes of the principal Act and this Act the expression "machinery" shall include any driving strap or band, and the expression "process" shall include the use of any locomotive.

Hoists, Prime Movers, Mill-gearing, and Dangerous Machinery.

Factory Acts,
1878, Sec. 5 ;
1891, Sec. 6 ;
1895, Sec. 7.

With respect to the fencing of machinery in a factory the following provisions shall have effect :—

(1) Every hoist or teagle, and every fly-wheel directly connected with the steam, or water or other mechanical power, whether in the engine-house or not, and every part of any water-wheel or engine worked by any such power shall be securely fenced ; and

(2) Every wheel-race not otherwise secured shall be securely fenced close to the edge of the wheel-race ; and

(3) All dangerous parts of the machinery and every part of the mill-gearing shall either be securely fenced or be in such position or of such construction as to be equally safe to every person employed or working in the factory as it would be if it were securely fenced ; and

(4) All fencing shall be constantly maintained in an efficient state while the parts required to be fenced are in motion or use, except where the parts are under repair or under examination in connection with repair, or are necessarily exposed for the purpose of cleaning or lubri-

cating, or for altering the gearing, or arrangement of the parts of the machine.

A factory in which there is a contravention of this section shall be deemed not to be kept in conformity with this Act.

Grinding in Tenement Factories.

(1) Where grinding is carried on in a tenement factory, the owner of the factory shall be responsible for the observance of the regulations set forth in the First Schedule to this Act. Factory Act, 1895, Sec. 25.

(2) In every such tenement factory it shall be the duty of the owner and of the occupier of the factory respectively to see that such parts of the horsing chains and of the hooks to which the chains are attached as are supplied by them respectively are kept in efficient condition.

(3) In every tenement factory where grinding or cutlery is carried on the owner of the factory shall provide that there shall at all times be instantaneous communication between each of the rooms in which the work is carried on and both the engine-room and the boiler-house.

(4) A tenement factory in which there is any contravention of this section shall be deemed not to be kept in conformity with the principal Act, but for the purposes of any proceeding in respect of a provision for the observance of which the owner of the factory is responsible, that owner shall be substituted for the occupier of the factory.

(5) This section shall not apply to a textile factory.

Schedule.

(1) Boards to fence the shafting and pulleys, locally known as drum boards, shall be provided and kept in proper repair.

(2) Hand rails shall be fixed over the drums and kept in proper repair.

(3) Belt guards, locally known as scotchmen, shall be provided and kept in proper repair.

(4) Every floor, which is constructed after the commencement of this Act, shall be so constructed and maintained as to facilitate the removal of slush, and all necessary shoots, pits, and other conveniences shall be provided for facilitating such removal.

(5) Every grinding-room or hull, which is established after the commencement of this Act, shall be so constructed that for the purpose of light grinding there shall be a clear space of three feet at least between each pair of troughs and for the purpose of heavy grinding there shall be a clear space of four feet at least between each pair of troughs and six feet at least in front of each trough.

(6) The sides of all drums in every grinding-room or hull shall be closely fenced.

(7) Except in pursuance of a special exemption granted by the Secretary of State, no grindstone shall be run before any fire-place or in front of another grindstone.¹

(8) No grindstone erected after the commencement of this Act shall be run before any door or other entrance.

Special Rules for Safety :—

Factory Act,
1891, Sec. 8.

(1) Where the Secretary of State certifies that in his opinion any machinery or process or particular description of manual labour used in a factory or workshop

¹The said regulation shall not apply to the running of any grindstone in front of bolster stones used by table-blade grinders, and humping and shank stones used by scissors grinders (order of Secretary of State, dated 25th October, 1897, granting a special exemption).

(other than a domestic workshop) is dangerous or injurious to health or dangerous to life or limb, either generally or in the case of women, children, or any other class of persons, or that the provisions for the admission of fresh air is not sufficient, or that the quantity of dust generated or inhaled in a factory or workshop is dangerous or injurious to health, the chief inspector may serve on the occupier of the factory or workshop a notice in writing, either proposing such special rules or requiring the adoption of such special measures as appear to the chief inspector to be reasonably practicable and to meet the necessities of the case.

(2) Unless within twenty-one days after receipt of the notice the occupier serves on the chief inspector a notice in writing that he objects to the rules or requirement, the rules shall be established, or, as the case may be, the requirement shall be observed.

(3) If the notice of objection suggests any modification of the rules or requirement, the Secretary of State shall consider the suggestion and may assent thereto with or without any further modification which may be agreed on between the Secretary of State and the occupier, and thereupon the rules shall be established, or, as the case may be, the requirement shall be observed, subject to such modification.

(4) If the Secretary of State does not assent to any objection or modification suggested as aforesaid by the occupier, the matter in difference between the Secretary of State and the occupier shall be referred to arbitration under this Act, and the date of the receipt of the notice of objection by the Secretary of State shall be deemed to be the date of the reference, and the rules shall be established, or the requisition shall have effect, as settled by an award or arbitration.

(5) Any notice under this section may be served by post.

(6) With respect to arbitrations under this Act the provisions in the First Schedule to this Act shall have effect.

(7) No person shall be precluded by any agreement from doing, or be liable under any agreement to any penalty or forfeiture for doing, such acts as may be necessary in order to comply with the provisions of this section.

Factory Act,
1891, Sec. 9.

(1) If any person who is bound to observe any special rules established for any factory or workshop under this Act acts in contravention of, or fails to comply with, any such special rule, he shall be liable on summary conviction to a fine not exceeding two pounds ; and the occupier of the factory or workshop shall also be liable on summary conviction to a fine not exceeding ten pounds, unless he proves that he had taken all reasonable means, by publishing, and to the best of his power enforcing, the rules to prevent the contravention or non-compliance.

(2) A factory or workshop in which there is a contravention of any requirement made under this Act shall be deemed not to be kept in conformity with the principal Act.

Factory Act,
1891, Sec. 10.

(1) After special rules are established under this Act in any factory or workshop the Secretary of State may from time to time propose to the occupier of the factory or workshop any amendment of the rules or any new rules ; and the provisions of this Act with respect to the original rules shall apply to all such amendments and new rules in like manner, as nearly as may be, as they apply to the original rules.

(2) The occupier of any factory or workshop in which special rules are established may from time to time pro-

pose in writing to the chief inspector, with the approval of the Secretary of State, any amendment of the rules or any new rules, and the provisions of this Act with respect to a suggestion of an occupier for modifying the special rules proposed by a chief inspector shall apply to all such amendments and new rules in like manner, as nearly as may be, as they apply to such a suggestion.

(1) Printed copies of all special rules for the time being in force under this Act in any factory or workshop shall be kept posted up in legible characters in conspicuous places in the factory or workshop where they may be conveniently read by the persons employed. In a factory or workshop in Wales or Monmouthshire the rules shall be posted up in the Welsh language also.

(2) A printed copy of all such rules shall be given by the occupier to any person affected thereby on his or her application.

(3) If the occupier of any factory or workshop fails to comply with any provision of this section he shall be liable on summary conviction to a fine not exceeding ten pounds.

(4) Every person who pulls down, injures, or defaces any special rules when posted up in pursuance of this Act, or any notice posted up in pursuance of the special rules, shall be liable on summary conviction to a fine not exceeding five pounds.

An Inspector shall, when required, certify a copy which is shown to his satisfaction to be a true copy of any special rules for the time being established under this Act for any factory or workshop, and a copy so certified shall be evidence (but not to the exclusion of other proof) of those special rules, and of the fact that they are duly established under this Act.

Factory Act,
1891, Sec. 11.

Factory Act,
1891, Sec. 12.

SPECIAL RULES FOR SAFETY ALREADY ESTABLISHED.

The Manufacture of Explosives in which Di-nitro benzole is used.

Under Factory
Act, 1891, Sec.
8-12.

I. No person to be employed without a medical certificate stating that he or she is physically fit for such employment.

II. An examination of the workers at their work to be made at least once a fortnight by a certifying surgeon, who shall have power to order temporary suspension or total change of work for any persons showing symptoms of suffering from the poison, or if after a fair trial he is of opinion that any person is by constitution unfit, he shall direct that such person shall cease to be employed.

III. A supply of fresh milk, and of any drug that the medical officer may consider desirable, shall be kept where the workers in his opinion may require it.

IV. No meals to be taken in the workrooms.

V. There shall be provided separate lavatories for men and women, with a good supply of hot water, soap, nail brushes, and towels, and whenever the skin has come in contact with di-nitro-benzole, the part shall be immediately washed.

VI. Overall suits and head coverings shall be supplied to all workers in shops where di-nitro-benzole is used, these suits to be taken off or well brushed before meals and before leaving the works, and to be washed at least once a week.

VII. Suitable respirators (capable of being washed), folds of linen, or woollen material of open texture, or other suitable material, shall be supplied to those workers liable to inhale dust, and the wearing of such respirators shall be urged where the workers derive benefit from their use.

VIII. Where di-nitro-benzole has to be handled, the

hands shall always be protected from direct contact with it, either by the use of india-rubber gloves (kept perfectly clean, especially in the inner side), or by means of rags, which shall be destroyed immediately after use.

IX. Where di-nitro-benzole is broken by hand, the instrument used shall be a wooden bar, spade, or tool with a handle long enough to prevent the worker's face from coming into near contact with the material.

X. In all rooms or sheds in which the process, either of purifying, grinding, mixing materials of which di-nitro-benzole forms a part, is carried on, efficient "cows," ventilating shafts, and mechanical ventilating fans shall be provided to carry off the dust or fumes generated.

XI. Drying stoves shall be efficiently ventilated, and, where possible, be charged and drawn at fixed times, and a free current of air shall be admitted for some time prior to the workers entering to draw either a part or the whole of the contents.

XII. In the process of filling cartridges, the material shall not be touched by hand, but suitable scoops shall be used, and where patent ventilated cartridge filling machines are not used, there shall be efficient mechanical ventilation arranged in such a manner that the suction shall draw the fumes or dust away from and not across or over the faces of the workers.

XIII. A register, in a prescribed form, shall be kept, and it shall be the duty of a responsible person named by the firm to enter at least once a week, a statement that he has personally satisfied himself that each and all of the special rules have been observed, or if not, the reasons for such non-observance. The surgeon to enter in this register the dates of his visits, the results of such visits, and any requirement made by him.

XIV. The "dipping" rooms to be efficiently ventilated.

Chemical Works.

I. In future every uncovered pot, pan, or other structure containing liquid of a dangerous character, shall be so constructed as to be at least 3 feet in height above the ground or platform. Those already in existence which are less than 3 feet in height, or in cases where it is proved to the satisfaction of an inspector that a height of 3 feet is impracticable, shall be securely fenced.

II. There shall be a clear space round such pots, pans, or other structures, or where any junction exists a barrier shall be so placed as to prevent passage.

III. Caustic pots shall be of such construction that there shall be no footing on the top or sides of the brickwork, and dome-shaped lids shall be used where possible.

IV. No unfenced planks or gangways shall be placed across open pots, pans, or other structures containing liquid of a dangerous character. This rule shall not apply to black ash vats where the vats themselves are otherwise securely fenced.

V. Suitable respirators shall be provided for the use of the workers in places where poisonous gases or injurious dust may be inhaled.

VI. The lighting of all dangerous places shall be made thoroughly efficient.

VII. Every place where caustic soda or caustic potash is manufactured shall be supplied with syringes or wash bottles, which shall be enclosed in covered boxes fixed in convenient places, in the proportion of one to every four caustic pots. They shall be of suitable form and size, and be kept full of clean water. Similar appliances shall be provided wherever, in the opinion of an inspector, they may be desirable.

VIII. Overalls, kept in a cleanly state, shall be provided for all workers in any room where chlorate of

potash or other chlorate is ground. In every such room a bath shall be kept ready for immediate use. In every chlorate mill, tallow or other suitable lubricant shall be used instead of oil.

IX. Respirators charged with moist oxide of iron or other suitable substance, shall be kept in accessible places ready for use in cases of emergency arising from sulphuretted hydrogen or other poisonous gases.

X. In salt cake departments suitable measures shall be adopted by maintaining a proper draught, and by other means to obviate the escape of low-level gases.

XI. Weldon bleaching powder chambers, after the free gas has, as far as may be practicable, been drawn off or absorbed by fresh lime, shall, before being opened, be tested by the standard recognised under the Alkali Act. Such tests shall be duly entered in a register kept for the purpose.

All chambers shall be ventilated, as far as possible, when packing is being carried on, by means of open doors on opposite sides and openings in the roof, so as to allow of a free current of air.

XII. In cases where the co-operation of the workers is required for carrying out the foregoing rules, and where such co-operation is not given, the workers shall be held liable in accordance with the Factory and Workshop Act, 1891, section 9.

Bichromate Works.

I. In future every uncovered pot, pan, or other structure containing liquid of a dangerous character shall be so constructed as to be at least 3 feet in height above the ground or platform. Those already in existence which are less than 3 feet in height, or in cases where it is proved to the satisfaction of an inspector that a height of

3 feet is impracticable, shall be securely fenced. In the case of gangways not exceeding 27 inches in width, which are hung down from the lip or edge of vessels, where it is impracticable, owing to the nature of the operation, to lower these to 3 feet, the depth of 20 inches will be considered sufficient.

II. There shall be a clear space round such pots, pans, or other structures, or where any junction exists a barrier shall be so placed as to prevent passage.

III. No unfenced planks or gangways shall be placed across pots, pans, or other structures containing liquid of a dangerous character.

IV. Respirators suitable for protection of nostrils and mouth shall be provided where injurious dust or noxious fumes may be inhaled.

V. The lighting of all dangerous places shall be made thoroughly efficient.

VI. Inasmuch as dust is the principal cause of the various evil results to workers in chromium compounds, all due means shall be taken to limit in every way the formation of dust.

VII. Gloves or finger stalls of some waterproof material shall be provided for the use of females engaged in sorting the crystals.

VIII. Sufficient lavatory accommodation, with hot and cold water, soap, nail brushes and towels shall be provided.

IX. In cases where the co-operation of the workers is required for carrying out the foregoing rules, and where such co-operation is not given, the workers shall be held liable in accordance with the Factory and Workshop Act, 1891, section 9.

*The Bottling of Aerated Water.**Duties of Occupiers.*

I. They shall provide all bottlers with face guards, masks, or veils of wire gauze. They shall provide all wirers, sighters, and labellers with face guards, masks, or veils of wire gauze or goggles.

II. They shall provide all bottlers with full-length gauntlets for both arms. They shall provide all wirers, sighters, and labellers, with gauntlets for both arms, protecting at least half of the palm and the space between the thumb and forefinger.

III. They shall cause all machines for bottling to be so constructed, so placed, or so fenced, as to prevent as far as possible, during the operation of filling or corking, a fragment of a bursting bottle from striking any bottler, wirer, sighter, labeller or washer.

Duties of Persons Employed.

IV. All bottlers shall, while at work, wear face guards, masks, or veils of wire gauze. All wirers, sighters, and labellers, shall, while at work, wear face guards, masks, or veils of wire gauze or goggles; except labellers when labelling bottles standing in cases.

V. All bottlers shall, while at work, wear on both arms, full-length gauntlets. All wirers, sighters, and labellers, shall, while at work, wear on both arms, gauntlets protecting at least half of the palm, and the space between the thumb and forefinger; except labellers when labelling bottles standing in cases.

CHAPTER XVII.

SAFE-WORKING.

Limitations on Employment about Machinery.

Factory Act,
1878, Sec. 9.

A CHILD shall not be allowed to clean any part of the machinery in a factory while the same is in motion by the aid of steam, water, or other mechanical power.

A young person or woman shall not be allowed to clean such part of the machinery in a factory as is mill-gearing while the same is in motion for the purpose of propelling any part of the manufacturing machinery.

A child, young person, or woman shall not be allowed to work between the fixed and traversing part of any self-acting machine while the machine is in motion by the action of steam, water, or other mechanical power.

A child, young person, or woman allowed to clean or to work in contravention of this section shall be deemed to be employed contrary to the provisions of this Act.

Factory Act,
1895, Sec. 8.

The first paragraph of section nine of the principal Act (which relates to the cleaning of machinery), shall apply, so far as the dangerous parts of machinery are concerned, to young persons in like manner as it applies to children, and for this purpose such parts of the machinery shall, unless the contrary is proved, be presumed to be dangerous as are so notified by an Inspector to the occupier of the factory.

Factory Act,
1895, Sec. 9.

(2) A person employed in a factory shall not be allowed to be in the space between the fixed and the

traversing portions of a self-acting machine unless the machine is stopped with the traversing portion on the outward run, but for the purpose of this provision the space in front of a self-acting machine shall not be included in the space aforesaid.

Special Rules restricting Employment.

(1) Section eight of the Act of 1891 shall extend to ^{Factory Act, 1895, Sec. 28.} authorise the making of special rules or requirements prohibiting the employment of, or modifying or limiting the period of employment for, all or any classes of persons in any process or particular description of manual labour, which is certified by the Secretary of State in pursuance of that section to be dangerous or injurious to health or dangerous to life or limb. Provided that any special rules or requirements under this section, which relate to the employment or period of employment of adult workers, shall be laid for forty days before both Houses of Parliament before coming into operation.

SAFE-CONSTRUCTION.

Position of Self-acting Machine.

(1) In a factory erected after the commencement of ^{Factory Act, 1895, Sec. 9.} this Act, the traversing carriage of any self-acting machine shall not be allowed to run out within a distance of eighteen inches from any fixed structure not being part of the machine, if the space over which it so runs out is a space over which any person is liable to pass, whether in the course of his employment or otherwise.

(3) A factory in which a traversing carriage is allowed to run out in contravention of this section shall be deemed not to be kept in conformity with the principal

Act, and any person allowed to be in the space aforesaid in contravention of this section, shall be deemed to be employed contrary to the provisions of the principal Act.

Dangerous Machines.

Factory Act,
1895, Sec. 4.

(1) A court of summary jurisdiction may, on complaint by an inspector, and on being satisfied that any machine used in a factory or workshop is in such a condition that it cannot be used without danger to life or limb, by order prohibit the machine from being used, or, if it is capable of repair or alteration, from being used until it is duly repaired or altered.

(2) Where a complaint has been made under this section the court or a justice may, on application *ex parte* by the inspector, and on receiving evidence that the use of any such machine involves imminent danger to life, make an interim order prohibiting either absolutely or subject to conditions the use of the machine until the earliest opportunity for hearing and determining the complaint.

(3) If there is any contravention of an order under this section, the person entitled to control the use of the machine shall be liable to a fine not exceeding forty shillings a day during such contravention.

Dangerous Factory or Workshop—Escape from Fire.

Factory Act,
1891, Sec. 7.

(1) Every factory of which the construction is commenced after the first day of January, one thousand eight hundred and ninety-two, and in which more than forty persons are employed, shall be furnished with a certificate from the sanitary authority of the district in which the factory is situate that the factory is provided on the storeys above the ground floor with such means of escape

in case of fire for the persons employed therein as can reasonably be required under the circumstances of each case, and a factory not so furnished shall be deemed not to be kept in conformity with the principal Act, and it shall be the duty of the sanitary authority to examine every such factory and on being satisfied that the factory is so provided to give such a certificate as aforesaid.

(2) With respect to all factories to which the foregoing provisions of this section do not apply and in which more than forty persons are employed it shall be the duty of the sanitary authority of every district, as soon as may be after the passing of this Act, and afterwards from time to time, to ascertain whether all such factories within their district are provided with such means of escape as aforesaid, and, in the case of any factory which is not so provided, to serve on the person being within the meaning of the Public Health Act, 1875, the owner of the factory a notice in writing specifying the measures necessary for providing such means of escape as aforesaid, and requiring him to carry out the same before a specified date, and thereupon each owner shall, notwithstanding any agreement with the occupier, have power to take such steps as are necessary for complying with the requirements, and, unless such requirements are so complied with, such owner shall be liable to a fine not exceeding one pound for every day that such non-compliance continues. In case of a difference of opinion between the owner of the factory and the sanitary authority, the difference shall, on the application of either party, be referred to arbitration, and thereupon the provisions of the first schedule to this Act shall have effect, except that the parties to the arbitration shall be the sanitary authority on the one hand and the owner on the other, and the award on the arbitration shall be

binding on the parties thereto. If the owner alleges that the occupier of the factory ought to bear or contribute to the expenses of complying with the requirement, he may apply to the County Court having jurisdiction where the factory is situate, and thereupon the County Court, after hearing the occupier, may make such order as appears to the court just and equitable under all the circumstances of the case.

Factory Act,
1895, Sec. 10.

(1) A court of summary jurisdiction may, on complaint by an inspector, and on being satisfied that the provision of a movable fire escape or movable fire escapes is required for the safety of any of the persons employed in a factory or workshop, by order require the occupier of the factory or workshop to provide and maintain a movable fire escape or movable fire escapes sufficient for that purpose.

(2) While any person employed in a factory or workshop is within the factory or workshop for the purpose of employment or meals, the doors of the factory or workshop, and of any room therein in which any such person is, shall not be locked or bolted or fastened in such a manner that they cannot be easily and immediately opened from the inside.

(3) In every factory or workshop the construction of which is commenced after the commencement of this Act, the doors of each room in which more persons than ten are employed, shall, except in the case of sliding doors, be constructed so as to open outwards.

(4) Sub-section one of section seven of the Act of 1891 shall apply to all workshops the construction of which is commenced after the commencement of this Act, and in which more than forty persons are employed, in like manner as it applies to factories, and sub-section two of that section shall apply to all workshops to which

the foregoing provision of this sub-section does not apply, in like manner as it applies to factories.

(5) For the purpose of enforcing the provisions of section seven of the Act of 1891 with respect to fire escapes, an inspector may give the like notice and take the like proceedings as under section four of the principal Act and section two of the Act of 1891, and the provisions of those sections shall apply accordingly.

(6) If there is any contravention of an order under this section the occupier of the factory or workshop shall be liable to a fine not exceeding forty shillings a day during such contravention, and a factory or workshop in which there is a contravention of the requirements of this section shall be deemed not to be kept in conformity with the principal Act.

(1) An application to refer, under section seven of the Factory Act, 1895, Sec. 11. Act of 1891, a difference as to a notice by a sanitary authority or by the London County Council must be made within one month after the time when the difference arises.

(2) Where such a difference is referred to arbitration, the notice of the sanitary authority or council shall be discharged, amended, or confirmed in accordance with the award in the arbitration.

Structural Defects.

(1) A court of summary jurisdiction may, on complaint Factory Act, 1895, Sec. 2. by an inspector, and on being satisfied that any place used as a factory or workshop or as part of a factory or workshop is in such a condition that any manufacturing process or handicraft carried on therein cannot be so carried on without danger to health or to life or limb, by order, prohibit the place from being used for the purpose of that process or handicraft, until such works have been

executed as are in the opinion of the court necessary to remove the danger.

(2) Provided that proceedings shall not be taken under this section in cases where proceedings might be taken by or at the instance of any sanitary authority under the provisions of the law relating to public health, unless the inspector is authorised to take proceedings in pursuance of section one or section two of the Act of 1891.

(3) If there is any contravention of an order under this section the occupier of the place shall be liable to a fine not exceeding forty shillings a day during such contravention.

LIABILITY AND PENALTIES.

Failure of Occupier to keep premises in conformity with Act.

Factory Act,
1878, Sec. 81.

If a factory or workshop is not kept in conformity with this Act, the occupier thereof shall be liable to a fine not exceeding ten pounds.

The court of summary jurisdiction, in addition to or instead of inflicting such fine, may order certain means to be adopted by the occupier, within the time named in the order, for the purpose of bringing his factory or workshop into conformity with this Act; the court may, upon application, enlarge the time so named, but if, after the expiration of the time as originally named or enlarged by subsequent order, the order is not complied with, the occupier shall be liable to a fine not exceeding one pound for every day that such non-compliance continues.

Employment by Occupier contrary to the Act.

Factory Act,
1878, Sec. 83.

Where a child, young person, or woman is employed in a factory or workshop contrary to the provisions of

this Act, the occupier of the factory or workshop shall be liable to a fine not exceeding three, or if the offence was committed during the night, five pounds for each child, young person, or woman so employed; and where a child, young person, or woman is so employed in a factory or workshop within the meaning of section sixteen of this Act, the occupier shall be liable to a fine not exceeding one, or if the offence was committed during the night, two pounds for each child, young person, or woman so employed.

A child, young person, or woman who is not allowed times for meals and absence from work as required by this Act, or during any part of the times allowed for meals and absence from work is, in contravention of the provisions of this Act, employed in the factory or workshop or allowed to remain in any room, shall be deemed to be employed contrary to the provisions of this Act.

*Breach of Safeguarding provisions or Special Rules by
Occupier where death or bodily injury is caused.*

If any person is killed or suffers any bodily injury in consequence of the occupier of a factory (including every laundry, dock, wharf, quay, and warehouse, and any premises using mechanical power for building purposes) having neglected to fence any machinery required by or in pursuance of this Act to be securely fenced, or having neglected to maintain such fencing, or in consequence of the occupier of a factory or workshop having neglected to fence any vat, pan, or other structure required by or in pursuance of this Act to be securely fenced or having neglected to maintain such fencing, the occupier of the factory or workshop shall be liable to a fine not exceeding one hundred pounds, the whole or any part of which may be applied for the benefit of the injured person or

Factory Act,
1878, Sec. 82,
and Factory
Act, 1895, Sec.
23.

his family, or otherwise as a Secretary of State determines ;

Provided that the occupier of a factory shall not be liable to a fine under this section, if an information against him for not fencing the part of the machinery, or the vat, pan, or other structure by which the death or bodily injury was inflicted, has been heard and dismissed previous to the time when the death or bodily injury was inflicted.

Factory Act,
1895, Sec. 13.

Section eighty-two of the principal Act, which provides penal compensation to persons injured by neglect to fence machinery, shall extend to any death or bodily injury or injury to health in consequence of the occupier of a factory or workshop having neglected to observe any provision of the Factory Acts, or any special rule or requirement made in pursuance of the Act of 1891. Provided that in the case of injury to health the occupier shall not be liable under this section unless the injury was caused directly by such neglect.

*Exemption of Occupier from liability on conviction
of actual offender.*

Factory Act,
1878, Sec. 86.

Where an offence for which the occupier of a factory or workshop is liable under this Act to a fine, has in fact been committed by some agent, servant, workman, or other person, such agent, servant, workman, or other person shall be liable to the same fine as if he were the occupier.

Factory Act,
1878, Sec. 87.

Where the occupier of a factory or workshop is charged with an offence against this Act, he shall be entitled, upon information duly laid by him to have any other person whom he charges as the actual offender, brought before the Court at the time appointed for hearing the charge ; and if, after the commission of the offence has been

proved, the occupier of the factory or workshop proves to the satisfaction of the Court that he had used due diligence to enforce the execution of the Act, and that the said other person had committed the offence in question without his knowledge, consent, or connivance, the said other person shall be summarily convicted of such offence, and the occupier shall be exempt from any fine. When it is made to appear to the satisfaction of an inspector at the time of discovering the offence that the occupier of the factory or workshop had used all due diligence to enforce the execution of this Act, and also by what person such offence had been committed, and also that it had been committed without the knowledge, consent, or connivance of the occupier and in contravention of his orders, then the inspector shall proceed against the person whom he believes to be the actual offender in the first instance, without first proceeding against the occupier of the factory or workshop.

Where, in pursuance of section eighty-seven of the principal Act, some person other than the occupier of a factory or workshop is brought before a Court of Summary Jurisdiction, and convicted of an offence with which the occupier was charged, that person shall in the discretion of the Court be liable to pay any costs incidental to the proceeding.

*Liability of Owner instead of Occupier in Tenement
Factories.*

In this Act, unless the context otherwise requires :—

(1) The expression “owner” has the meaning given to it by section four of the Public Health Act, 1875.

(1) Where mechanical power is supplied to different parts of the same building occupied by different persons for the purpose of any manufacturing process or handicraft in such manner that those parts constitute in law

Factory Act,
1895, Sec. 50.

Factory Act,
1895, Sec. 24.

separate factories, the owner (whether or not he is one of the persons so in occupation) of the building (which building is hereafter in this Act referred to as a tenement factory) shall, instead of the occupier, be liable for the observance, and punishable for non-observance, of the following provisions, namely :—

(b) Sections five and eighty-two of the principal Act, with respect to the fencing of machinery in a factory, except so far as those sections relate to such parts of the machinery as are supplied by the occupier ;

(3) Sections eight to eleven of the Act of 1891 shall, if and as far as in the case of a tenement factory the Secretary of State by order so directs, apply as if the owner of the factory were substituted for the occupier.

(4) The provisions of this Act with respect to the power to make orders in the case of dangerous premises shall apply in the case of a tenement factory as if the owner were substituted for the occupier.

(5) Where by or under this section, the owner of a tenement factory is substituted for the occupier with respect to any provisions of the Factory Acts, any summons, notice, or proceeding, which for the purpose of any of those provisions is by the said Acts or any of them authorised or required to be served on or taken in relation to the occupier, is hereby authorised or required (as the case may be) to be served on or taken in relation to the owner.

(6) For the purpose of the provisions of this Act with respect to tenement factories all buildings situate within the same close or curtilage shall be treated as one building.

(7) This section shall not apply in the case of any occupier paying a rent in excess of two hundred pounds a year.

Cumulative Fines and Minimum Penalties.

A person shall not be liable in respect of a repetition of the same kind of offence from day to day to any larger amount of fines than the highest fine fixed by this Act for the offence, except :—

- (a) Where the repetition of the offence occurs after an information has been laid for the previous offence ; or
- (b) Where the offence is one of employing two or more children, young persons, or women, contrary to the provisions of this Act.

The fine imposed on a conviction under sections sixty-eight, eighty - one, eighty-two, or eighty - three of the principal Act, for any offence in relation to a factory, shall, in case of a second or subsequent conviction for the same offence within two years from the last conviction for that offence, be not less than one pound for each offence.

Factory Act,
1878, Sec. 88.

Factory Act,
1891, Sec. 28.

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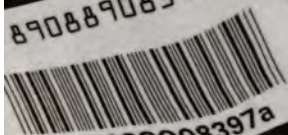
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